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The use of emissions trading in relation to other means of reducing emissions

A Nordic comparative study

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Nordic Environmental Co-operation

The Nordic Environmental Action Plan 2005-2008 forms the framework for the Nordic countries' environmental co-operation both within the Nordic region and in relation to the adjacent areas, the Arctic, the EU and other international forums. The programme aims for results that will consolidate the position of the Nordic region as the leader in the environmental field. One of the overall goals is to create a healthier living environment for the Nordic people.

The Nordic Co-operation on Economy and Finance

Nordic co-operation in the area of economy and finance includes consultations on stabilisation policies, studies and discussion of strategies for structural policies, evaluation of adjustment policies for the European economic integration process as well as support to the economic transformation process in Eastern- and Central Europe. The work in this area is governed by the Ministers of Finance and Economy and they are assisted by a Nordic Committee of Senior Government Officials.

Nordic co-operation

Nordic co-operation, one of the oldest and most wide-ranging regional partnerships in the world, involves Denmark, Finland, Iceland, Norway, Sweden, the Faroe Islands, Greenland and Åland. Co-operation reinforces the sense of Nordic community while respecting national differences and similarities, makes it possible to uphold Nordic interests in the world at large and promotes positive relations between neighbouring peoples.

Co-operation was formalised in 1952 when *the Nordic Council* was set up as a forum for parliamentarians and governments. The Helsinki Treaty of 1962 has formed the framework for Nordic partnership ever since. The *Nordic Council of Ministers* was set up in 1971 as the formal forum for co-operation between the governments of the Nordic countries and the political leadership of the autonomous areas, i.e. the Faroe Islands, Greenland and Åland.

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Preface

The Environment and Finance Working Group and the Climate Change Policy Working Group of the Nordic Council of Ministers, has commissioned ECON Analysis to prepare this report "The use of emissions trading in relation to other means of reducing emissions - a Nordic comparative study".

The Environment and Finance Working Group and the Climate Change Policy Working Group does not necessarily share the views and conclusions of the report, but looks at is as a contribution to our knowledge about the emissions trading in relation to other means of reducing emissions of greenhouse gasses.

Oslo, May 2006

Jon D. Engebretsen
Chairman
Climate Change Policy Working Group

Copenhagen, May 2006

Jørgen Schou
Chairman
Environment and Finance Working Group

Summary

Abstract

This study analyzes how the Nordic countries have dealt with or plan to deal with the conditions of the EU emissions trading system (EU ETS) and the relation to other measures to curb emissions. Concerning the use of emissions trading and other instruments, there are a lot of similarities among the Nordic countries, but also some fundamental differences. Given the information available so far, Denmark and Finland will make extensive use of the EU ETS and government purchase of credits through the Kyoto mechanisms to reach their commitments in the period 2008–2012. Norway anticipates that the emissions reductions attained through domestic policies and measures will not be sufficiently large to reach the Kyoto commitment and the use of the flexible mechanisms will hence be an important part of the strategy. However, the division between the use of emissions trading and government purchase of credits through the Kyoto mechanisms is not yet decided. Sweden's use of emissions trading is still not decided, but the current national emission target does not include emission reductions using the flexible mechanisms. Iceland, finally, will not take part in the EU ETS in the period 2008–2012. So far, the introduction of the ETS has led to relatively small adjustments of existing instruments in the Nordic countries. Thus, many instruments are still used in parallel with the ETS. In the study we conclude that the large number of energy and climate policy instruments that are used in the Nordic countries may interact in a suboptimal way. This suggests that the marginal incentive to reduce greenhouse gases provided by each instrument should be assessed in a systematic economic analysis of all climate policies in use.

Background

All Nordic countries have ratified the Kyoto Protocol, and therefore have binding commitments to reduce their greenhouse gas (GHG) emissions to the period 2008–2012. The Nordic countries also have a tradition of relatively tough environmental policy. For quite a long time they have had explicitly formulated climate change strategies and have used various measures intended to curb emissions.

Since 1 January 2005 an emissions trading scheme is in operation within the European Union ("the EU ETS"), after several years of preparation. As members of the union, Denmark, Finland and Sweden were obliged to implement the EU ETS. Norway has developed a domestic emissions trading scheme, which shadows, and most likely will be connected to, the EU ETS. Iceland neither takes part in the EU ETS nor has a national emissions trading scheme.

The EU ETS does not cover all sectors of society. At present, it is confined solely to CO_2 emissions from installations in heat and power production and in energy-intensive industry. When setting climate policies the Nordic countries must take this in to account, and try and find the right balance between emissions trading and other means of reducing emissions. In view of this, the Nordic Council of Ministers has commissioned ECON, in co-operation with Electrowatt-Ekono of Finland, to conduct a comparative study of how the Nordic countries intend to make emissions trading work together with existing climate strategies.

Problem statement

This study analyzes how the Nordic countries intend to make emissions trading work together with other climate policy instruments. The study has comprised of two parts. The first part contained a comparative analysis of some aspects of how the Nordic countries have dealt with the conditions of the EU ETS in the present period, 2005–2007, and the relation to other measures to curb emissions. The second part of the study has been focused on implications of the EU ETS for the Nordic countries in 2008–2012. This report contains the results of the study's both phases.

In accordance with the assignment from the Nordic Council of Ministers, the study has put special emphasis on economical effects. The main focus for the study has been the following question:

In what way have other climate policy instruments, and the Nordic countries' climate strategies in general, been affected by the introduction of emissions trading?

The study's main findings

The Nordic countries' use of instruments other than emissions trading is in many ways similar…

In some ways the prerequisites for carrying out climate change policies differ between the Nordic countries. For instance, due to varying industrial and energy production structures, the size of total emissions vary between the countries. Furthermore, the Nordic countries' international emission reduction commitments, and the challenges it will mean to reach them, vary quite a lot, with the extremes being Iceland and Denmark. Thus, Iceland can allow for an increase in current emission levels of more than 10 percent to the commitment period (2008–2012) and still reach its target, whereas Denmark needs to cut its emissions by approximately 20 percent to be able to reach its target.

Still, there are a lot of similarities in the way the Nordic countries have chosen to battle climate change. Thus, albeit the application of different measures may vary, by and large the Nordic countries use the same kind of policy instruments in order to reduce GHG emissions, for instance:

- *Carbon dioxide taxes*. All Nordic countries except Iceland use a CO_2 tax. Generally, the tax is levied on the use of fossil fuels in relation to their carbon contents. However, there are differences in how the tax is imposed, e.g. a number of different exemptions are used.
- *Energy related taxes*. All Nordic countries use energy related taxes, but the tax design differs between countries. The purpose of the energy related taxes are primarily fiscal. But the taxes also have an effect on energy consumption and on CO_2 emissions.
- *Long-term, voluntary agreements*. Some sort of voluntary agreements between industry and the government are used in all Nordic countries. These agreements typically mean that the concerned industry, for instance, gets a reduction of the CO_2 tax rate and in exchange has to carry out energy saving investments.
- *Subsidies and green certificate systems*. Subsidies to renewable energy production and energy conservation are used in all Nordic countries except Iceland. Of the Nordic countries, Sweden is so far the only one that has introduced a system of green certificates, but other Nordic countries are considering doing so.
- *Use of JI and CDM*. Denmark and Finland has announced that they intend to use credits from Joint Implementation (JI) and the Clean Development Mechanism (CDM) in order to fulfil their Kyoto commitments. Norway has indicated that the mechanisms will be used if necessary. Sweden has a programme for JI and CDM, but has not yet decided in what way the credits will be used.

…and so is the implementation of emissions trading in the Nordic countries 2005–2007

Except for Iceland, all Nordic countries have introduced emissions trading for the period 2005–2007. There are, for natural reasons, strong similarities in the implementation among the Nordic EU Member States. The Norwegian implementation differs somewhat, mostly due to a substantially lower coverage. The main elements of the implementations are summarized in table A below. Information about Norway refers to the national ETS, which will probably be connected to the EU ETS.

Table A Main elements in the introduction of emissions trading in the Nordic countries 2005–2007

	Denmark	Finland	Norway	Sweden
Trading sector's share of emissions[1]	60 % of CO_2 emissions, 47 % of all GHG emissions	71 % of CO_2 emissions, 60 % of all GHG emissions	16 % of CO_2 emissions, 13 % of all GHG emissions	42 % of CO_2 emissions, 33 % of all GHG emissions
Number of installations (approx.)	350	550	50	700
Total allocation, yearly average 2005–2007	33.5 million tonnes	45.5 million tonnes	6.8 million tones	22.9 million tonnes
Allocation compared to recent emissions	Power and heat production: 96 % of 2002 emissions Others: 110 % of 2002 emissions	Power and heat production: 105 % of average emissions 1998–2002 / 2000–2003 Others: 119 % of average emissions 1998–2002	Power and heat production: 95 % of average emissions 1998–2001 Others: 95 % of average emissions 1998–2001	Power and heat production: 80 % of average emissions 1998–2001 Others: 100 % of average emissions 1998–2001. 100 % of projected process emissions.
Auctioning	Yes, 5 % of total allocation	No	No	No
Opt-in/Opt-out	No/No	Yes/No	No/"Yes"[2]	Yes/No
Allocation method for existing installations (base years)	Grandfathering (1998–2002)	Grandfathering (1998–2002 on general, but 2000–2003 for condensate power plants)	Grandfathering (1998–2001) or expected emissions	Grandfathering (1998–2001)
Allocation method for new entrants	Benchmarking	Benchmarking	Based on ex-pected CO_2 emissions	Benchmarking

Notes: [1] The share is calculated as 'Total allocation, yearly average 2005–2007' in relation to the yearly average for total emissions in the years 1999–2003 (as shown in table 2.2). [2]) Norway has chosen a trading regime in which emissions from burning of fossil fuels that are subject to CO_2 tax is exempted from the regime. This could perhaps be described as an "opt-out", and is the main reason why the Norwegian ETS is of relatively limited scope.

Changes in climate policy instruments due to emissions trading so far are only marginal…

How the Nordic countries' climate strategies will finally be affected by the introduction of emissions trading is really too early to say, since the climate strategies presently are under revision in many of the countries. Thus, Finland (late 2005) and Sweden (March 2006) have recently presented new, or at least revised, climate strategies, while Iceland will probably do so later this year. One of the circumstances that have brought about the need for revision is the introduction of emissions trading.

So far, the introduction of emissions trading seems to have led to relatively marginal corrections of the former climate strategies. In the EU Member States Denmark, Finland and Sweden the EU ETS seems hitherto to have been mainly implemented *alongside* existing policy instruments and to have led to only minor corrections of existing instruments. To some extent this seems to be true also of Norway. But since Norway is not an EU Member State, it could choose a somewhat different approach in the introduction of emissions trading. Thus, Norway uses emissions trading as a *complement* to CO_2 taxation, by excluding CO_2 taxed emissions from the ETS.

The main changes in other climate related measures due to the introduction of emissions trading that so far *has occurred*, can be summarized in the following fashion:

- *Denmark*: The national emissions trading system that for some years had been in operation in order to curb carbon dioxide emissions from electricity production was abolished in 2005, due to the obvious overlapping with the EU ETS.
- *Finland* has introduced a CO_2 tax relief on heat production with peat and removal of subsidies for electricity generation with peat. The main reason for these changes was to compensate for the loss of competitiveness against other fuels caused by the introduction of the EU ETS.
- *Norway*: There are emissions from several industries (i.e. process emissions from aluminium etc.) that neither are covered by the EU emissions trading directive, nor by the Norwegian CO_2 tax. The Norwegian government decided that some policy instruments should be directed towards these emissions as well. Therefore a new agreement on emissions reductions was signed between these industries and the authorities.
- *Sweden*: Some changes have been made in the environmental legislation. Thus, the requirements in the Environmental Code concerning restrictions on emissions of carbon dioxide and on the quantity of fossil fuel used have been removed for plants covered by the EU ETS.

…but further changes are proposed

According to theoretical studies and numerous quantitative assessments the interaction between energy and climate policy instruments is often complex. Hence, different measures can act together in a counterproductive way, thus increasing the overall cost of reaching the goal. The case where CO_2 emissions trading is used with CO_2 taxation on the same emitter is an apparent example where multiple instruments might hinder a cost effective outcome.

Based on the cost efficiency aspiration declared in the climate strategies, one should expect the Nordic countries to make some adjustments of pre-existing policy instruments. There are now clear indications that steps are taken in that direction. For example, both Sweden and Denmark are in the process of reducing the emission trading industries' CO_2 tax burden, and Finland will lower the electricity tax on industry within the ETS. However, other climate policy related instruments applied on the trading sectors, such as green certificates systems and subsidies, are still used in parallel with the ETS. This could interfere with the cost effectiveness of the emissions trading system. One should however bear in mind that some of these instruments, like the green certificate system, have other policy objectives.

Balancing the use of ETS and other instruments involves uncertainty and complex decisions

Due to the partial sectoral coverage of the EU ETS there is a problem of "balancing" emissions trading with the use of instruments in the non-trading sector to achieve the Kyoto commitment. The chosen balance will have implications for the cost of reaching the emission target. However, many variables that are important for the decision are still highly uncertain. Central variables are e.g. the cost of further emissions reductions in the non-trading sector, i.e. mainly emissions from transport and heating; the price of credits from JI and CDM projects (and the cost of raising public funds to purchase programs); and the future price of allowances within the EU ETS.

So far, there have only been indications on how the countries will handle this "national burden sharing" in the period 2008–2012. Denmark, Finland and Norway anticipate that the future emission reductions in the non-trading part of the economy will not be sufficient to attain the emission target. These countries therefore see the flexible mechanisms as an important part of their policies. In the case of Norway, however, it should be noted that the size of the non-trading part of the economy is still uncertain and an expansion of the current limited sectoral coverage may be proposed. Sweden, on the other hand, has an indicative emissions target for the transport sector which specifies that large emissions reductions ought to be achieved in this sector.

Table B summarizes the Nordic countries chosen policy balance based on the information available so far.

Table B The Nordic countries planned use of EU ETS and other instruments 2008–2012

	Denmark	Finland	Norway	Sweden
Kyoto gap	17.3 Mt CO_2 eq. per year[1]	11 Mt CO_2 eq. per year	11 Mt CO_2 eq. per year	-0.7 Mt CO_2 eq. per year (but 2.1 Mt above current national target)
EU ETS	Not yet decided. (No explicit restriction on use of JI/CDM credits indicated in national implementation of the Linking directive.)	Not yet decided. (Estimated 5.9 Mt reductions per year used in latest "with measures" projections.)	Not yet decided. (Low coverage of current domestic system reduces the possible use. Discussions on including e.g. the offshore petroleum activities, which would increase the possible use of the ETS.)	Not yet decided. (Allocation proposed to be based on the current national target. Proposed restrictions on the use of JI and CDM credits within the ETS. The ETS could not be used toward the current national target.)
Government use of the Kyoto mechanisms	The government will buy approx. 4.5 Mt per year.	The government plans to buy approx. 2.4 Mt per year	Not yet decided but it is foreseen that the government will acquire Kyoto units if necessary to fulfil the commitment	Approx. 1 Mt per year through pilot programs. (Not yet decided how these credits will be used. Could not be used toward the current national target.)
Domestic policies and measures	Largely under investiga-tion. (No overall tax increase but possibly tax differentiation. Subsidies to renewable energy. Energy labeling of buildings.)	Approx. 1 Mt per year in total estimated. (Energy conservation important. Attained largely through agreements, energy audits and other energy conservation programmes. Transport related measures will reduce approx. 0.5 Mt per year.)	Small future reductions estimated. (CO_2 tax and voluntary agreements with industry. CO_2 tax on transports is the main instrument to limit emissions. Proposed increase in the tax rate on domestic aviation, domestic shipping of goods and supply ship. Targets on each sectors contribution will be presented.)	Should be used to fulfil the national target, 2.1 Mt per year. (Large number of measures used and proposed. No estimate of effects provided. Indicative (strict) sector specific target concerning the emissions of CO_2 from transports. Increased use of renewables by using green certificates.)

Note: 1) The gap may be reduced to 12.3 Mt if corrections are made for electricity export in the base year 1990

Given the uncertainty concerning the price of emission allowances, the cost to the economies from far-reaching use of the EU ETS is still highly unsure. It is also very much dependent on the policy balance chosen by other European countries. A number of quantitative assessments point toward potentially large direct and indirect effects on some of the trading sectors' international competitiveness. This indicates that, at least in the longer run, costly structural changes may be brought about. At the same time, other studies indicate that further emission reductions through policies and measures on non-trading sectors may be costly.

In general, participants in the EU ETS call for stable and foreseeable conditions. However, due to the prevailing uncertainty in several dimensions and the dependence on other countries' choices, decisions concerning the policy balance are difficult to make and for the time being it may even be valuable to postpone decisions.

1. Introduction

1.1 Background

The Nordic countries have a tradition of relatively tough environmental policy. For quite a long time they have also had explicitly formulated climate change strategies and have used various measures intended to curb emissions, e.g. Denmark, Finland, Norway and Sweden all introduced a carbon dioxide tax on fossil fuel consumption in the early 1990's.

In recent years, however, the conditions for setting climate policies have been transformed to a certain extent, since on 1 January 2005, a scheme for trading in emission allowances ("emissions trading") was introduced in the EU. In the implementation of this scheme in the Nordic countries, the question of how to make it work together with existing climate strategies has been of great importance.

The EU Emissions Trading Scheme (EU ETS) is based on a directive that was formally adopted in October 2003.[1] The EU ETS comprises various time periods. The first period (2005–2007) is partly intended as a learning experience. The following periods will run in five-year cycles, i.e. 2008–2012, 2013–2017 etc.

Emissions trading is a market-based instrument of climate policy, which is commonly regarded as the most cost-effective and economically efficient way of reducing emissions. The EU ETS does, however, possess some characteristics that separate it from a theoretically ideal emissions trading scheme, for example:

- The EU ETS does not cover all sectors of society. In the first period (2005–2007), it is confined solely to CO_2 emissions from installations in energy-intensive industry (production and processing of ferrous metals, minerals, and paper, paperboard and pulp) and combustion units with capacity above a certain level (20 MW) in heat and power production. In the whole EU, the system covers roughly 12 000 installations. The European Commission has estimated that the scheme will cover approximately 46 percent of the projected EU CO_2 emissions in 2010.
- The majority of the emission allowances are not allocated through auctioning in the EU ETS. Thus, the directive states that EU Member States are to allocate at least 95 percent of the emission allowances

[1] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC (OJ No. L 275, Volume 46, 25 October 2003).

free of charge during the three-year period 2005−2007. For the first commitment period, 2008−2012, at least 90 percent are to be distributed free of charge.
- The principles for allocating emission allowances free of charge for the period 2008–2012 have not been clearly specified yet, at least not in detail. This creates an element of uncertainty for the carbon market in the present period.
- Other climate policy instruments have on general not been subject to European harmonization.

The overall conditions for the EU ETS in the period 2008–2012 are to a large extent given by the directive. However, some adjustments in the trading scheme for the period 2008–2012 will most likely be realized during 2006. Thus, in the first part of 2006 the European Commission will work out a proposal for changes in the EU ETS for the period 2008–2012. The proposal shall then be negotiated between the Member States and approved during 2006. At present, it can be anticipated that the negotiations only will lead to relatively minor changes, e.g. the trading scheme will probably not be amended with more greenhouse gases or sectors (with the possible exception of aviation) already in 2008.

Subject for the study

The design and implementation of the EU ETS raises some questions of special interest to the Nordic countries that take part in the scheme. One such aspect is that the Nordic countries use other greenhouse gas related measures to a larger extent than most other European countries, which could have implications for the effectiveness of the trading scheme. In addition to effectiveness issues, possible elimination, or at least reduced use of other measures, e.g. CO_2 taxes, for sectors covered by the ETS could also have fiscal consequences. Furthermore, Sweden has introduced (and other Nordic countries are considering doing so) a system of green certificates in order to increase the amount of power production based on renewable sources. This also affects the conditions for setting and obtaining climate change targets. The existence of a common Nordic power market also gives cause for a special Nordic perspective on the EU ETS.

In view of the forthcoming negotiations on the conditions of the EU ETS for 2008–2012, and the somewhat special conditions for implementing the EU ETS in the Nordic countries, the Nordic Council of Ministers has commissioned ECON, in co-operation with Electrowatt-Ekono of Finland, to conduct a study of how the Nordic countries intend to make emissions trading work together with other climate policy instruments. The study is to put special emphasis on economical effects

The main focus for the study has been the following question:

- In what way have other climate policy instruments, and the Nordic countries' climate strategies in general, been affected by the introduction of emissions trading?

In accordance with the assignment from the Nordic Council of Ministers, the study has been carried out in two phases. The first phase comprised of a comparative analysis of some aspects of how the Nordic countries have dealt with the conditions of the EU ETS in the present period, 2005–2007, and the relation to other measures to curb emissions. The preliminary results of the first phase were presented to and discussed with the Nordic Council of Ministers in September 2005. The second phase of the study has focused on implications of the EU ETS for the Nordic countries in 2008–2012.

Since the report deals with the relation between emissions trading and other instruments, it is mainly focused on Denmark, Finland, Sweden (as they are EU Member States) and Norway (which has a national emissions trading scheme that will most likely be connected to the EU ETS). Thus, Iceland, which neither takes part in the EU ETS nor has a national emissions trading scheme, is generally left out of the discussion. Iceland is, however, included when we discuss climate targets and emission levels more in general (see chapter 2).

The sources that have been used for the study consist, to a large extent, of various official documents (e.g. the Nordic countries' climate strategies, National Allocation Plans, and National Communications under the UNFCCC), but also of other sorts of background material; see the enclosed list of references.

The report has been written by ECON. The information about Finland, and vital comments on the report, has mainly been provided by Electrowatt-Ekono.

1.2 Contents of the report

Although the work of the study has been carried out in two phases, this report, which contains the results of the study's both phases, is not structured strictly in accordance with the two phases. Instead, in order to better reflect the main question of the study, we have chosen a more thematic presentation. Thus, after an overview of the Nordic countries' emission targets, levels and projections is given in *Chapter 2*, we deal with the question of in what way other climate policy instruments, and the Nordic countries' climate strategies in general, have been affected by the introduction of emissions trading in the following fashion:

First, we discuss how, from a theoretical viewpoint, the introduction of emissions trading could be affected by other climate policy instruments and the Nordic countries' climate strategies in general. Thus, in

Chapter 3 we discuss emissions trading in combination with other instruments from a more theoretical standpoint. Then, in *Chapter 4*, we analyze results from various model based quantitative assessments (some general, but mainly studies concerning the Nordic countries) of the effects from the introduction of emissions trading. All of these studies were done before the EU ETS had actually started. In fact, several of the studies were carried out directly in connection with governmental ex ante investigations of how the EU ETS should be implemented.

Secondly, we discuss how, in practice, the introduction of emissions trading so far seems to have affected other climate policy instruments and the Nordic countries' climate strategies in general. Thus, in *Chapter 5* we discuss the introduction of emissions trading in the Nordic countries. We present the main features of emissions trading in the period 2005–2007, the development so far, and discuss how the conditions might change in the period 2008–2012. Then, *Chapter 6* contains a comparative analysis of the use of instruments other than emissions trading in the Nordic countries'. In chapter 6, we also analyze to what extent these instruments have been affected by the introduction of emissions trading, and the outlook of the Nordic countries' climate strategies for the period 2008–2012.

Chapter 7 consists of a summary and discussion.

2. Emission targets, levels and projections

All Nordic countries have ratified the Kyoto Protocol. This implies that all countries have a binding greenhouse gas (GHG) emission reduction commitment for the period 2008–2012.

In order to describe the challenges the Nordic countries will meet in trying to fulfil their Kyoto commitments, we in this chapter give a brief overview of the Nordic countries' emission targets (2.1), their historic and current emission levels (2.2), and their projected future emissions (2.3).

2.1 Emission targets

All Nordic countries except Sweden have a national emission target that corresponds to their commitment according to the Kyoto Protocol. Sweden, on the other hand, has adopted a stricter emission target in its national climate strategy.

A country's emission reduction commitment according to the Kyoto Protocol refers to the period 2008–2012 and is set in relation to the country's 1990 emissions – this is also the way that Sweden's national target is set. The Nordic countries' emission targets, in relation to emissions in 1990, are shown in table 2.1 together with emissions for the years 1990 and, which is the latest available statistics for all countries, 2003.

As is shown in table 2.1, the countries' emission targets vary quite a lot. Some countries need to make substantial reductions compared to their 1990 emissions, while others even can increase their emissions. For comparisons sake, it should be mentioned that total EU15 emissions need to be reduced by approximately 5 percent from the current level, if the combined EU15 target under the Kyoto Protocol of an 8 percent reduction is to be reached.

Table 2.1 The Nordic countries' emission targets

	GHG emissions 1990 (million tonnes CO_2 equivalents)	Target for 2008–2012 (in % relative to 1990)	Target for 2008–2012 (calculated as million tonnes CO_2 equivalents)	GHG emissions 2003 (million tonnes CO_2 equivalents)
Denmark	69.3	-21 %	54.7	73.9
Finland	70.5	0 %	70.5	85.6
Iceland	3.3	+10 %	3.6	3.1
Norway	50.1	+1 %	50.6	54.8
Sweden	72.2	-4 %	69.3	70.6

Some explanatory comments about the emissions targets need to be made about Denmark, Iceland and Sweden:

- *Denmark.* According to the EU burden sharing agreement, Denmark's commitment for the period 2008–2012 corresponds to annual emissions of just below 55 million tonnes. However, a final decision on what the Danish commitment will mean in terms of tonnes has not yet been made. Denmark's emissions were unusually low in 1990, since Danish power plants produced less than usual due to large electricity imports from Norway and Sweden, made possible by heavy rainfall. Denmark has argued that the country should be compensated for this. If the EU agrees (it will be decided in 2006), Denmark will be allowed to emit just under 60 million tonnes CO_2 equivalents annually from 2008–2012.
- *Iceland.* The Icelandic obligations according to the Kyoto Protocol are two fold. First of all, as is shown in table 2.1, the greenhouse gas emissions shall not increase more than 10 percent from the level of emissions in 1990. However, as a relatively small economy in which individual sources of industrial process emissions can have a significant proportional impact on emissions at the national level, Iceland has also in one respect been awarded special status in the Kyoto Protocol. Thus, in line with Decision 14/CP.7, additional emissions of up to 1.6 million tonnes originating from large single projects initiated after 1990 shall be reported separately and carbon dioxide emissions from them not included in national totals. In Iceland's case, these conditions mainly concerns abrupt increases in emissions from aluminium production associated with the possible expansion of production capacity of this industry.
- *Sweden.* According to the EU burden sharing agreement, Sweden's emissions of the Kyoto Protocol's greenhouse gases are to be limited to 104 percent compared to the 1990 level in the first commitment period. However, according to a decision by the Swedish Parliament in 2002[2], Swedish emissions of greenhouse gases for the period 2008–2012 are to be at least four percent lower than emissions in 1990.

[2] Prop. 2001/02:55, bet. 2001/02:MJU10, rskr. 2001/02:163.

> According to the national target, emissions during this period shall at most correspond to 96 percent of emissions in 1990 without compensation for absorption in carbon sinks or by flexible mechanisms. In its proposal for a revised climate strategy, the Swedish government has recently stated that the target for 2008–2012 shall remain as was decided in 2002.[3] Complementing this, a more long-time target is also introduced. Thus, the government proposes that the emissions for Sweden in 2020 should be 25 percent lower than in 1990. Through a set of checkpoints every five years, starting 2008, the development will be continuously reviewed.

It must be emphasized that the Kyoto commitments relate to 2008–2012, and that none of the Nordic countries have an explicit emission target for the period 2005–2007. Furthermore, it is not possible to give a certain prediction of whether the countries will reach their targets or not, solely by observing past and current emission levels and the target for 2008–2012. The optimal path depends on, among other things, the country's industrial structure and could therefore differ between the Nordic countries.[4] It is therefore not un-complicated to identify if the countries are progressing optimally toward the target and how large the emissions should be in the period 2005–2007. Still, the differing sizes of the gap between current emission levels and the Kyoto target at least indicates that the Nordic countries' efforts to meet their Kyoto commitments in the coming years will be of varying difficulty.

2.2 Historic and current emission levels

How the Nordic countries' GHG emissions in total have evolved since 1990 is shown in table 2.2 below. Since the EU ETS at present only includes CO_2, the table also shows the evolvement of CO_2 emissions.

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[3] Prop. 2005/06:172.

[4] If, for example, the policymaker wish to avoid large premature retirement of the current capital stock it could be optimal to postpone abatement. See e.g. Grubb (1997) for a discussion on economic issues of the timing of abatement.

Table 2.2 Evolvement of total GHG emissions (in million tonnes CO_2 equivalents) and of carbon dioxide emissions (in million tonnes) in the Nordic countries

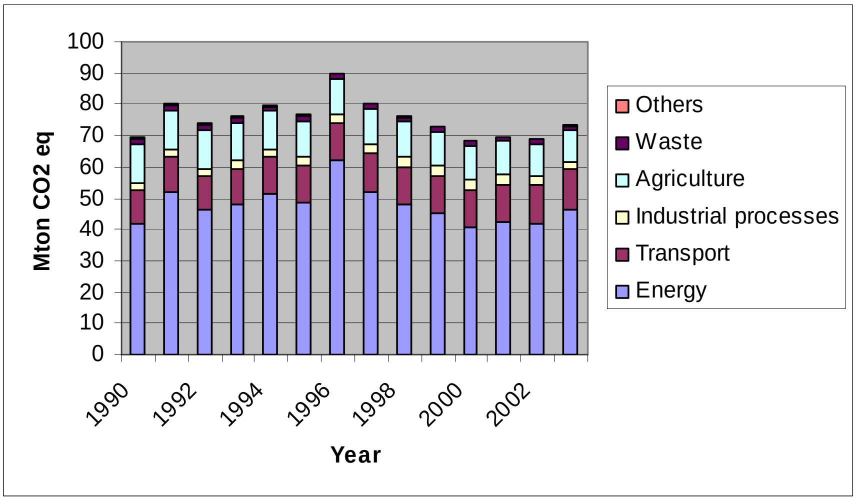
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Denmark														
-Total GHG	69.3	80.0	73.8	76.2	79.7	76.7	90.0	80.3	76.1	72.9	68.3	69.7	69.0	73..9
-CO_2	52.9	63.6	57.8	60.1	63.7	60.6	74.0	64.5	60.4	57.5	53.1	54.6	54.3	59.2
Finland														
-Total GHG	70.5	69.5	66.8	67.9	74.4	71.6	76.9	76.0	72.9	72.5	70.2	75.8	77.2	85.6
-CO_2	56.3	55.8	53.8	54.7	61.1	58.1	63.4	62.3	59.5	59.2	57.6	63.2	65.0	73.2
Iceland														
-Total GHG	3.3	3.1	3.0	3.1	3.0	3.1	3.2	3.4	3.4	3.6	3.3	3.2	3.1	3.1
-CO_2	2.1	2.0	2.1	2.2	2.2	2.2	2.3	2.4	2.3	2.5	2.3	2.2	2.2	2.2
Norway														
-Total GHG	50.1	48.3	46.0	48.0	50.0	49.6	52.8	52.9	53.3	54.3	53.8	55.3	53.5	54.8
-CO_2	34.4	33.5	33.8	35.4	37.3	37.2	40.4	40.6	40.8	41.6	41.1	42.7	41.2	43.2
Sweden														
-Total GHG	72.2	72.5	72.2	72.0	74.7	73.4	77.2	72.7	73.2	69.9	67.3	68.3	69.5	70.6
-CO_2	56.3	56.7	56.5	56.1	58.7	57.6	61.2	56.8	57.5	54.7	52.4	53.5	54.8	56.0

Source: The Nordic countries' 2005 National Inventory Reports to the UNFCCC, Miljøministeriet (2005), www.naturvardsverket.se

As is obvious from table 2.2, emissions vary quite a lot over the years in the Nordic countries, especially in Denmark and Finland. The differences are largely due to hydrological and climatological factors, which lead to variations in the availability of hydroelectric power in the Nordic energy system. When there is a lot of, mainly Norwegian and Swedish, hydroelectric power available (e.g. 2000), the need for Danish and Finnish fossil-fuelled power production is lower, and vice versa. In dry years (e.g. 1996) the Danish and Finnish coal condensing plants are used more intensively, and the electricity exported to other countries, leading to considerably higher GHG emissions in Denmark and Finland.

The evolvement of emissions on sector level for each country is illustrated in figures 2.1–2.5 below. It should be noted that the sector division in the figures does not follow the sector division of the EU ETS, since there are no official statistics of the latter. However, the installations that are covered by the EU ETS are mainly to be found in the sectors 'energy' and 'industrial processes', whereas 'transport' for instance is not covered by the EU ETS. Compared to the EU ETS, it should also be noted that figures 2.1–2.5 show total GHG emissions, not only CO_2.

Figure 2.1 Denmark's total GHG emissions on sector level

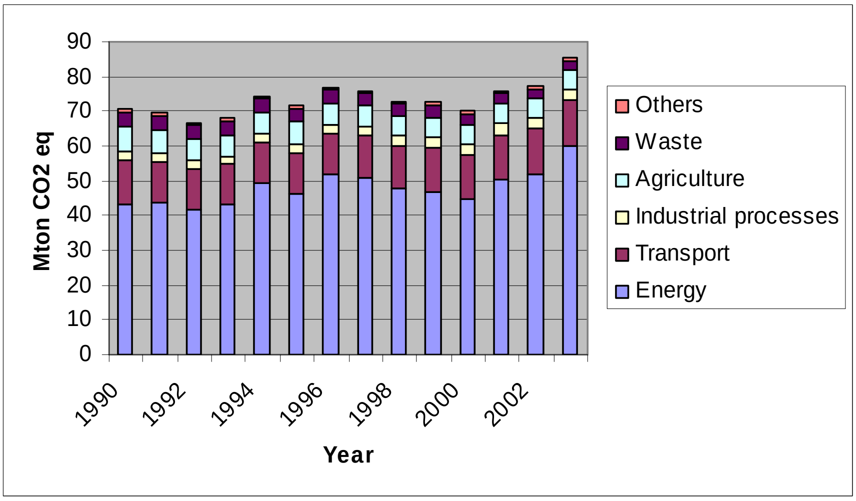


Source: Denmark's 2005 National Inventory Report to the UNFCCC, Miljøministeriet (2005)

In Denmark, total GHG emissions show a clear "cyclical" variation over the years. As was mentioned earlier, this is mainly due to variations in energy production. The energy sector also stands for a substantial part of Denmark's emissions.

Due to the "cyclical" variation, it is difficult to distinguish a clear long-term trend for Denmark's total emissions. On sector level, however, the long-term trend for emissions is clearly increasing in the transport sector and clearly decreasing in the agricultural sector.

Figure 2.2 Finland's total GHG emissions on sector level

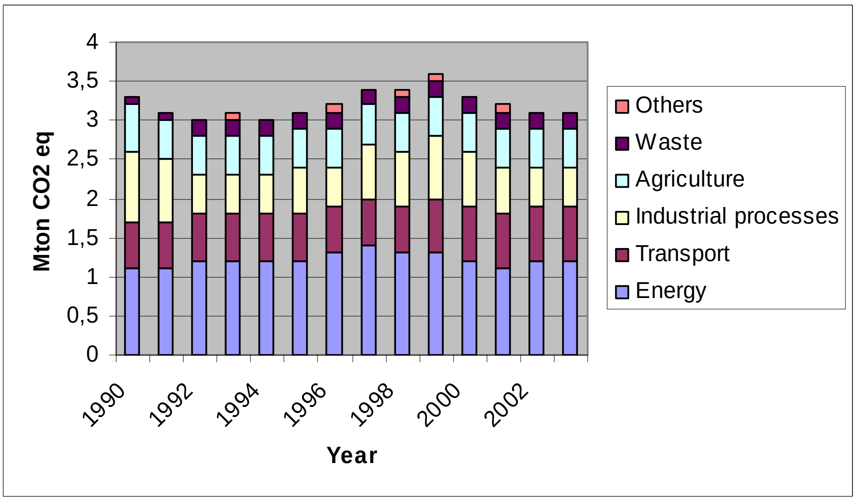


Source: Finland's 2005 National Inventory Report to the UNFCCC

Over the years, Finland's emissions show a similar, cyclical variation as the Danish emissions. In contrast to Denmark, however, the long term trend for Finland's emissions is clearly increasing. Both the cyclical variation and the long-term increasing trend can mainly be explained by the emission patterns of the energy sector, which stands for a big part of Finland's emissions.

Waste and agriculture are the Finnish sectors whose emissions most clearly show a long-term decreasing trend.

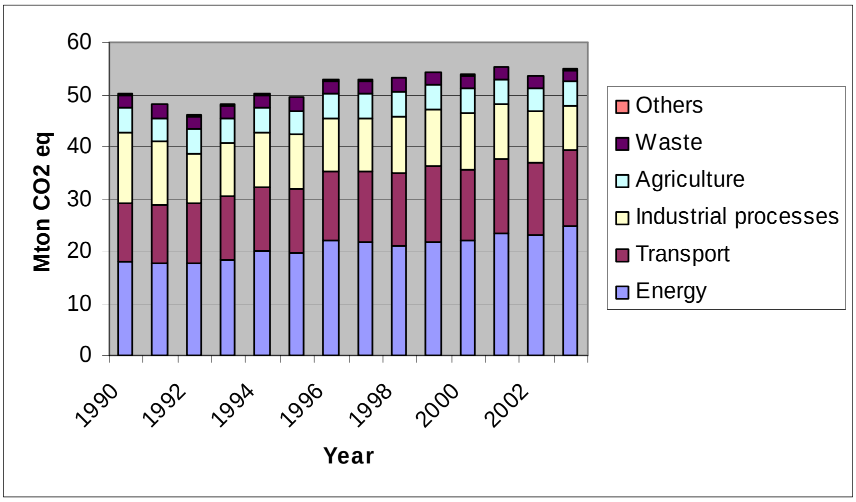
Figure 2.3 Iceland's total GHG emissions on sector level



Source: Iceland's 2005 National Inventory Report to the UNFCCC

Judging by figure 2.3, Iceland's emissions are rather stable over the years. On the other hand, the above-mentioned effects of Decision 14/CP.7 should also be considered. Thus, additional emissions of up to 1.6 million tonnes originating from large single projects initiated after 1990 shall be reported separately and carbon dioxide emissions from them not included in national totals. This means that the de facto long term trend of Iceland's emissions is increasing.

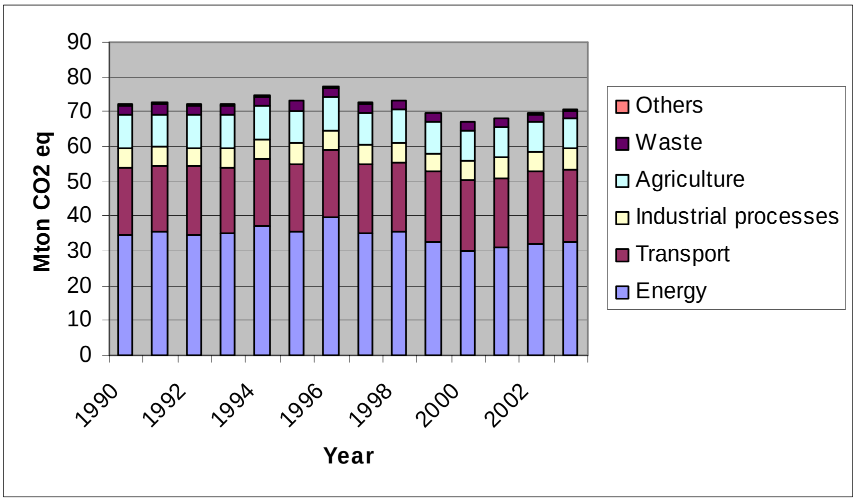
Figure 2.4 Norway's total GHG emissions on sector level



Source: Norway's 2005 National Inventory Report to the UNFCCC

Norway's emissions show no obvious cyclical variations over the years. The long-term trend of total emissions seems, however, to be increasing, with the biggest increases coming from energy production and transport. One Norwegian sector whose emissions show a significantly decreasing long-term trend is industrial processes.

Figure 2.5 Sweden's total GHG emissions on sector level



Source: Sweden's 2005 National Inventory Report to the UNFCCC

As figure 2.5 illustrates, due to variations in energy production, Sweden's emissions to some extent show the same cyclical pattern as Denmark's and Finland's. However, in contrast to especially Finland, the long-term trend of Swedish emissions seems to be slightly decreasing.
One sector, whose emissions both make up a big part of Sweden's total emissions and show a long term increasing trend, is the transport sector.

Relative variations

Finally, in order to round up the discussion of the Nordic countries' historic and current emission levels, it should be noted that the countries' emissions vary both in absolute and relative terms. The variation in absolute terms is clearly illustrated by table 2.2 and the figures above. The variation in relative terms can be illustrated by calculations of emissions in relation to the countries' Gross Domestic Products (GDP) and per capita (see table 2.3).

Table 2.3 Total GHG emissions in relation to GDP and per capita (2003 data for emissions and GDP, 2004 data for population)

	GHG emissions in relation to GDP (tonnes CO_2 equivalents per MUSD)	*GHG emissions per capita (tonnes CO_2 equivalents)*
Denmark	351	13.7
Finland	528	16.5
Iceland	295	10.7
Norway	248	11.9
Sweden	234	7.8

Source: The Nordic countries' 2005 National Inventory Reports to the UNFCCC, Miljøministeriet (2005), www.naturvardsverket.se (emissions), IMF's World Economic Outlook Database, www.imf.org (GDP), www.norden.org (population)

2.3 Projected future emissions

We concluded section 2.1 by saying that the differing sizes of the gap between current emission levels and the Kyoto target indicates that the Nordic countries' efforts to meet their Kyoto commitments in the coming years will be of varying difficulty.

The challenges the Nordic countries will meet in trying to fulfil their Kyoto commitments can also be illustrated by their projected future emissions. Table 2.4 shows the latest available official projections for each country. In order to facilitate a comparison with historic and current emission levels, the table is structured in a similar way as table 2.2, i.e. it shows total GHG emissions and CO_2 emissions.
On general, the projections have been made as a with measures scenario.[5] This means that the projections reflect the policies and policy instruments

[5] In the Icelandic projection, however, the expected effects of the key measures of the climate change policy have been integrated (a "with additional measures" projection).

that were established at the time, but do not take in to account instruments that will be implemented in the coming years in order to curb emissions. It should be noted that the projections therefore do not represent the most probable future evolvement of emissions.

Due to the varying conditions under which the projections were made (e.g. they were made by each country individually and at different points in time), caution should be used when comparing them. For instance, the EU ETS has been taken in to consideration in the Danish, and Swedish projections, but not in the Finnish and Norwegian projections. In the case of Norway, neither has the domestic ETS.[6]

Table 2.4 Projections of future total GHG emissions (in million tonnes CO_2 equivalents) and of CO_2 emissions (in million tonnes) in the Nordic countries

	1990	2003	2008–2012	Projection 2008–2012 relative to 1990	Target for 2008–2012 relative to 1990	2020
Denmark[1]						
-Total GHG	69.3	73.9	72.3	+4 %	-21 %	67.2
- CO_2	52.9	59.2	59.0	---	---	55.2
Finland						
-Total GHG	70.5	85.6	80.8	+14 %	0 %	82.1
- CO_2	56.3	73.2	66.8	---	---	70.7
Iceland[2]						
-Total GHG	3.3	3.1	2.8 [3.0]	-15 %	+10 %	2.8 [3.1]
-CO_2	2.1	2.2	2.3 [2.4]	---	---	2.3 [2.4]
-CO_2 emissions fulfilling 14/CP.7	0	0.4	0.4 [1.5]	---	---	0.4 [1.6]
Norway						
-Total GHG	50.1	54.8	61.8	+23 %	+1 %	68.7
-CO_2	34.4	43.2	49.9	---	---	57.0
Sweden						
-Total GHG	72.2	70.6	71.2	-1 %	-4 %	76.3
-CO_2	56.3	56.0	57.7	---	---	63.1

Source: The Nordic countries' 2005 National Inventory Reports to the UNFCCC, Danish Ministry of the Environment and the Danish Environmental Protection Agency (2005a), Finnish Ministry of the Environment (2006), Ministry for the Environment in Iceland (2003), Norwegian Ministry of the Environment (2006), www.naturvardsverket.se, Swedish Environmental Protection Agency and The Swedish Energy Agency (2004)

Notes: [1]) If the EU eventually agrees with Denmark (it will be decided in 2006) that the country's emissions in 1990 were unusually low (due to large electricity imports from Norway and Sweden) and therefore should be adjusted, the commitment for 2008–2012 will be approximately 60 Mt CO_2 eq, i.e. approximately -13 % relative to 1990. [2]) Iceland presented two scenarios in its third national communication under the UNFCCC. The first one assumes no additions to energy intensive industries other than the expansions already agreed upon in October 2001. The second scenario was based on the assumption that a new aluminium smelter will be built, and that both of the existing aluminium plants will be enlarged. Numbers for scenario 2 (which would lead to substantially increased emissions in line with Decision 14/CP.7) are shown in brackets.

[6] It should also be noted that the Norwegian projections are based on preliminary technical assumptions and should be regarded as tentative. The government will present new long-term projections in 2006 (Norwegian Ministry of the Environment, 2006).

On sector level, the projected emissions show similar patterns as those that were illustrated in figures 2.1–2.5. Thus, on general the projected future emissions from the transport sector show an increasing trend in the Nordic countries. Emissions from the energy sector are also projected to increase in the countries, albeit the emissions from the Danish energy sector are expected to decrease after 2015. That emissions from the energy sector are projected to increase even in Norway and Sweden, where these kinds of emissions so far have been low, are mainly due to the expected introduction of new gas fired power plants (Norway), and the expected, continued dismantling of nuclear power plants (Sweden). In Norway, a substantial part of the projected increase in emissions is also expected to come from petroleum offshore activities.

Finally, when studying the projections, a remark from the Swedish National Allocation Plan for 2005–2007[7] is worth mentioning, since it might have general bearings. As was pointed out earlier, in this chapter we have chosen to describe the evolvement of emissions on sector level with a different sector division than that of the EU ETS, since there are no official statistics of the latter. However, in terms of the sector division of the EU ETS, the Swedish NAP shows that over the years there has been a “transition” in Sweden’s emissions from the non-trading sector to the trading sector, i.e. the trading sector’s share of emissions has increased and the non-trading sector’s share has consequently been reduced. Thus, a transition from individual to district heating of housing and premises has been stimulated by energy and carbon dioxide taxation. The additional heat and combined heat and power production that can be foreseen is expected to entail some increase in emissions in the trading sector that partly corresponds to reductions in the non-trading sector. Furthermore, increased emissions from the refinery sector, that ensue due to requirements of other community legislative and policy instruments, are also partly balanced by relative reductions in emissions in the transport sector.

[7] Swedish Ministry of Industry, Employment and Communications (2004).

3. ETS combined with other instruments – theoretical issues

3.1 Introduction

Within environmental and energy policy in general and climate policy in particular it appears as if there is a tendency to introduce new policy instruments without removing or adjusting the instruments already in use. Even if each of the measures used might be rational in themselves, there is clearly a risk that they, when analyzed together, could interact in a way that reduces the effectiveness of the overall climate policy. Given this potential risk, the effect of using multiple instruments has been given surprisingly little attention in both the academic and the policy debate. So far, analysis has mostly been focused on the effectiveness of one instrument at the time. The issue has however been given somewhat more attention lately as the need for understanding of these issues has increased with the introduction of the EU ETS. For example, research funded by the OECD and the European Commission recently analyzed the effects of emissions trading in combination with other instruments.[8] Within the Nordic countries, which has a relatively long tradition in using different emissions related instruments, there is lacking assessments of how the different climate and energy policy related instruments interact.

There are several ways in which policy instruments could interact. From a general equilibrium perspective it is likely that all instruments will interact in some way or another. For example, within the literature concerning green tax reforms it has been shown that the cost of using one instrument is highly dependent on the pre-existing distortions caused by other instruments.[9] In this study, however, we focus on interactions between the EU ETS and (major) instruments that are aimed at mitigating greenhouse gases in the Nordic countries (e.g. CO_2 tax) or a closely related target (e.g. green certificates) and/or which are connected to the use of fossil fuels (e.g. energy tax).

3.2 The effects of using multiple instruments

In general it is often stated that one should use one instrument per goal. That is, it is seldom a good idea to use e.g. carbon taxes on polluters if

[8] Johnstone (2002), Sorrell (2003), Sorrell and Sijm (2003), Sijm and van Dril (2003).

[9] For example, pre-existing tax distortions could through the "tax-interaction effect" increase the cost of environmental taxes (see e.g. Bovenberg and de Mooij, 1994, and Goulder, 1996).

they at the same time are covered by an emissions trading system. The principal advantage of an emissions trading system is that it achieves an environmental goal, i.e. the emission cap, at the lowest cost to society automatically through the market mechanism. From a CO_2 efficiency perspective any policy that disturbs the polluters' mitigation decision within the trading system is costly to society. The use of multiple instruments therefore has to be justified by other reasons. There are two main rational reasons for using additional instruments; (i) to correct for market failures and (ii) to achieve other policy objectives.

Some market failures are likely to be present although, ideally, the emissions trading system should give the participants the correct incentives to abate emissions, invest in carbon efficient equipment and conduct research that aims at achieving reduced emissions. However, due to external effects, the incentives to reach the optimal amount of investment and research may not be given by the price of emission allowances. For example, early investment in carbon efficient technology might be beneficial to society if investment and use of the technology is characterised by e.g. knowledge spillovers leading to social rates of return to R&D in excess of the private rates of return.[10]

Other policy objectives such as raising public revenues, mitigating "secondary emissions" from fossil fuels consumption, and income distributional issues could also motivate the use of multiple instruments.

3.2.1 Emissions trading and emission taxes

Using an emission tax as a "safety valve"

In theory, the choice between quantity regulating instruments such as an ETS with an emissions cap, and a price regulating instrument such as an emission tax, does not matter given that the cost and benefits are known with certainty. By using any of these instruments, the policymaker can reach the optimal emission level at the same cost. If there is uncertainty involved, however, the instrument choice matters. Weitzman (1974) showed that this instrument choice depends on the relative slope of the marginal cost and marginal benefits curves of abatement. In general, if there is uncertainty of the marginal cost of emission reductions, while at the same time the marginal benefit curve is known to be relatively flat, then it is optimal to use a price regulating instrument. This result is due to the fact that with a flat marginal benefit curve the cost of misjudging the effect of the price regulating instrument is small. If the emission target is fixed by a quantity regulating instrument, on the other hand, the cost of misjudging the position of the cost curve might be substantial if the marginal abatement cost is increasing steeply.

[10] See e.g. Jaffe et al. (2001).

Based on this observation Roberts and Spence (1976) showed that there are situations when a combination of a trading system and an environmental tax instrument is preferable to a single instrument. For this to hold, it is required that the cost of abatement is uncertain and that the environmental damage curve is non-linear, i.e. two conditions that applies to many environmental problems. By using emissions trading and an emission tax that put an upper bound on the price of allowances, the welfare cost from misjudging the marginal abatement cost can be reduced. Such a combination of instruments is often referred to as an ETS with a so-called safety valve, e.g. an ETS with a fixed per unit penalty for non-compliance, which in principle is a combination of emissions trading and an emission tax.[11]

Although an ETS with a safety valve feature is preferable in many situations it has the drawback that it does not guarantee that the emission target is reached. Including a safety valve feature in the EU ETS could result in a substantial burden for the non-trading sectors due to the fixed cap put on the EU by the Kyoto agreement. That is, if the safety valve is used any emission increase in the trading sector would need to be "corrected" by an increased use of measures in the non-trading part of the economy. To be effective, the safety valve price cap should apply to both the trading and non-trading sectors, but this is obviously not possible because this could result in non-compliance with the absolute emissions target.

EU ETS and CO_2 taxation

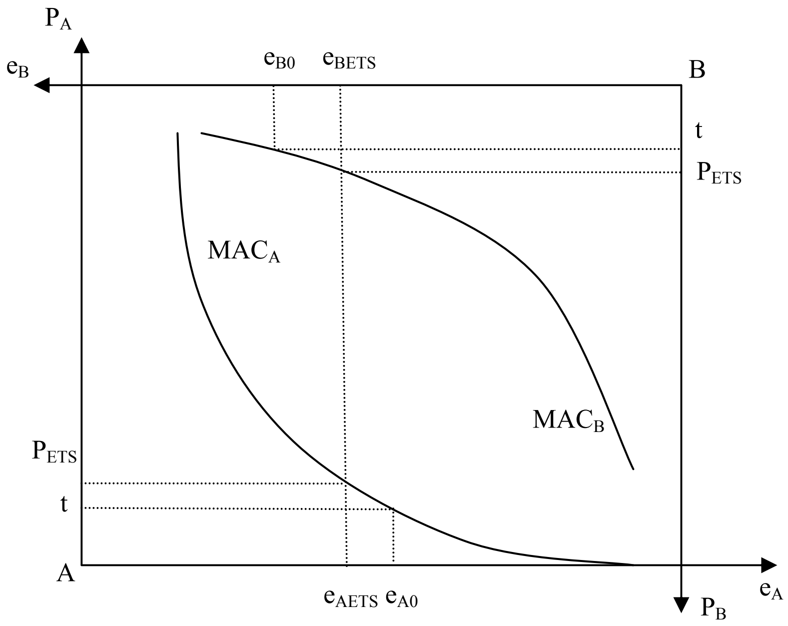
As described above, a combination of emissions trading and taxes could be preferred in some situations. However, in optimum the two instruments are never used simultaneously, i.e. only one instrument is applied at any point in time. Within the EU ETS some Member States use a CO_2 tax or charge which at least partly is levied on the sectors covered by the trading system. Nevertheless, by taxing CO_2 emissions that are included in the ETS there is no gain in effectiveness within the system due to the emissions cap. In fact, it is quite possible that the effect will be the opposite, i.e. lower economic effectiveness, which is illustrated in the following example.

If all Member States taxed emissions at a common tax rate this would result in a decrease in the price of allowances and also set a lower bound for the price of emitting CO_2 (when the price of allowances reaches zero). This is illustrated in the box diagram in figure 3.1, which consists of two merged "abatement cost diagrams" for country A and country B with marginal abatement cost represented by MAC_A and MAC_B, respec-

[11] See e.g. Ellerman and Jacoby (2002) and Pizer (2003) for a discussion on ETS with a safety valve. It should be noted that the EU ETS does not include this safety valve feature because in addition to the 40 Euro penalty (in the first trading period) the non-complying installation is required to hand in the missing allowances, i.e. the penalty does not cap the price.

tively.[12] If these two countries together start up an ETS with an emission cap corresponding to the base of the box, the allowance price would be P_{ETS} and the emission levels would be e_{AETS} and e_{BETS} for country A and B, respectively. If both countries tax emissions with the tax $t < P_{ETS}$ the outcome of the ETS will not be affected. The result will only be that the price of permits decrease to $P_{ETS} - t$. That is, the price of allowances will decrease with an amount corresponding to the tax rate. However, if the tax exceeds P_{ETS}, higher abatement levels will result in total emissions that are lower than the emission cap and the price of allowances will be zero.

Figure 3.1 Emissions trading with emission tax



I the case where the emission tax levels differ, e.g. if an emission tax is applied unilaterally by only one country, the tax might undermine the primary aim of the ETS which is to achieve a given emission target at least cost. This is realised by starting from a situation where the ETS is used without CO_2 tax. In figure 3.1 that would correspond to a situation with an allowance price of P_{ETS} and emission levels of e_{AETS} and e_{BETS} for country A and B respectively. If country A, in this situation, introduces a tax on CO_2 emissions the allowance price will not adjust fully as in the case where both countries introduced the tax. Instead the tax will increase the marginal cost in country A, which will reduce the emissions in that country. This in turn will result in more allowances available for country B, and reduce the price of allowances somewhat until a new equilibrium

[12] In the box diagram country B's "cost of abatement diagram" has been turned upside down on top of country A's "cost of abatement diagram". The side of the box (the x-axes) exactly matches the assumed emission cap for both countries together, i.e. the cap for the emissions trading system.

is reached. In this equilibrium country A will emit less than in the situation without the tax and pay a price that is higher than P_{ETS}. Country B, on the other hand will emit more than before and pay a price that is less than P_{ETS}. Thus, the abatement cost on the margin will differ between countries but the emission level will be unchanged, i.e. a situation that clearly differs from the optimality condition with equal abatement cost at the margin in all countries.

3.2.2 Emissions trading, subsidies, green certificates and regulations

There are currently a number of subsidies used to promote the use of climate friendly technology or renewable fuels within the Nordic countries..[13] The subsidy could be levied on investment in a certain technology or directly on the price of using renewable fuels or on climate related R&D. The subsidy could also be given by issuing renewable electricity (green) certificates together with a renewable electricity quota obligation on electricity users. The potential for interaction between the ETS and these kinds of instruments differs depending on what type of subsidy that is considered. As pointed out by e.g. Johnstone (2002), a subsidy on inputs related to abatement of greenhouse gases (e.g. subsidies on renewable energy inputs) will shift the marginal and average abatement cost curve down. An investment subsidy, on the other hand will shift the average abatement curve down but leave the short-run marginal abatement curve unchanged. This imply that the investment subsidy will not in any major way affect the allowance price in the short run, but through effects on the timing and the scale of investments it will affect the trading system in the longer run.

Subsidies on the use of renewable energy sources

There is a clear connection between the use of tradable CO_2 allowances and the profitability of renewable energy sources – higher allowance price will make renewables relatively more attractive. In the case with subsidies on the use of renewable fuels, the effect would be similar to the use of a carbon dioxide tax. That is, the subsidy will change the relative price of fossil fuels and renewable fuels and therefore make fossil fuels less attractive. However, contrary to the use of a carbon dioxide tax the subsidy does not stimulate abatement through other means than substituting toward the use of renewables. Given that a well functioning ETS will attain the emission target at least cost, a subsidy on the input of renewables will clearly distort the market and therefore be inefficient. Thus, using government funds to provide an "additional" advantage subsidy must be justified on other grounds than attaining climate related targets at the least cost to society.

[13] See chapter 6.

Subsidies on investment and R&D

Ideally, the ETS should give the correct incentive to invest in energy efficient and renewable energy technology by making such technologies more profitable. The use of investment and R&D subsidies on carbon efficient technologies in addition to an ETS could clearly disturb the market and thereby increase the overall cost of reaching the emission reduction target. However, as was pointed out earlier, it may be rational to subsidize investments and R&D. This is the case if it is believed that there are external effects from these activities that would make social rates of return to investment and R&D in excess of the private rates of return created by the emissions trading system. Such increase social rates of return could for instance come from of "learning-by-doing" effects and knowledge spillovers.

Green certificates

A green (renewable energy) certificate system is in many ways similar to direct subsidies to renewable energy use but with the important difference that the certificate system is financed within the energy sector and that it guarantees that a certain amount of renewable energy will be used. In some countries green certificates are used in parallel with CO_2 emissions trading. The two systems do not imply that two instruments are used to reach the same target. The renewable energy target may, at least partly, be established on other grounds than mitigating climate impact, such as security of supply through using domestically produced fuels. However, as the goals are interconnected the price on the CO_2 market will affect the price of green certificates.

If the CO_2 allowance price is high enough for renewable energy production to become an attractive alternative to fossil fuels, the use of renewables may be higher than the required quota obligation set within the green certificate system. In this case the price of green certificates will fall to zero and there will be no impact on the emissions trading system. If the price of CO_2 allowances stays below the level that induce the sufficient use of renewables, then the green certificate price will be positive and will therefore disturb the CO_2 market and bring on an inefficiently high use of renewables from a CO_2 mitigation perspective. Thus, the "inefficiency" must be justified by other reasons than reduction of CO_2 emissions, such as e.g. security of supply.

Regulations

In general regulations that focus on carbon dioxide emissions are incompatible with emissions trading. The reasoning is analogous to what has been described above. By putting further binding restrictions on emissions trading sectors the outcome is likely to be non-optimal from a carbon efficiency perspective. For example, by regulating (some) emissions trading industries to use the "best available technology" with respect to

CO_2 emissions, it is likely that too costly emission reduction will take place in the industry. The result will be a disturbed market with a suboptimal increase in emissions elsewhere within the trading system, equivalent to the effects in the CO_2 tax example discussed above.

3.3 Conclusions

In this chapter, we have briefly discussed some theoretical issues concerning the use of emissions trading in combination with other instruments, particularly the effects of using multiple instruments. In order to summarize the discussion, we would especially like to emphasize the following:

The theory clearly indicates that an ETS in many instances is an efficient instrument. There are nevertheless situations where price regulation instruments, such as an emission tax or an ETS with a price cap, are preferable. However, when the emission target level has to be attained due to e.g. binding agreements, a pure cap-an-trade system is likely to achieve the goal in an efficient manner.

In general, the use of tax and/or subsidies on emissions and sectors covered by the ETS, with the purpose of contributing to emission reductions is not recommended. At best, when policies are internationally coordinated, the instruments will have no effect on effectiveness. If the instruments are applied unilaterally in an uncoordinated manner, the result will most likely be a reduced environmental effectiveness. Any instruments used on the trading sectors, e.g. fossil fuel related taxes or subsidies to renewable fuel use, has to be motivated by some other goal than emission reductions. These other kinds of goals could for instance be revenue raising, security of energy supply or for equity reasons.

Given that the EU ETS is in place and functioning properly it appears to be appropriate for policy makers to review their use of other instruments. The loss of environmental effectiveness from using ETS alongside other instruments should be compared with the additional benefits these instruments might have. This may be particularly important for the Nordic countries which have many other CO_2 related instruments in place.

4. Effects from ETS and other instruments – quantitative studies

In all Nordic countries beside Iceland, some quantitative assessments have been made of the effects from the introduction of emissions trading for greenhouse gases. Several of these studies have been carried out directly in connection with governmental investigations. Although numerous aspects of the use of emissions trading and other instruments could be analysed, two aspects seems to have been of specific interest for Nordic policymakers: The effect on energy intensive industry competing on the international market and the overall effect on the economy from the use of emissions trading. Other issues such as distributive concerns have received less attention.

Given the options for policymakers when it comes to closing their emissions gap it is clear that the results from such quantifications may be of high importance for guidance and understanding. For example, the effect on energy intensive industry will provide an indication of how much of the burden that could be allocated to the trading sector without severely affecting the competitiveness of the companies in the trading sector. Furthermore, the calculations of the overall effects could be used to judge the aggregate cost to the economy from specific "burden sharing" between the trading sectors, non-trading sectors and governmental JI/CDM purchase programs.[14]

In this chapter we mainly discuss results from studies carried out in conjunction with official investigations within Nordic countries. Results from some other comparable studies are, however, also examined. The focus is on model based studies which looks at effects from the EU ETS. The discussion is divided in to four parts (which are presented in 4.1–4.4 and then summarized in 4.5):

(i) The aggregate economic effects from using the EU ETS relative to using domestic measures
(ii) The implications on the competitiveness of the energy intensive sectors
(iii) The EU ETS used in combination with other instruments (applied within the trading system)
(iv) The use of ETS and the burden on the non-trading sector

[14] That is, governmental plans to use public funds to implement concrete projects to reduce greenhouse gases in other countries. A JI is joint implementation of projects in other industrialised countries and CDM is projects in collaboration with developing countries on the development of cleaner technology. See section 5.2.2 for a description of these so-called Kyoto mechanisms..

This division, at least to some extent, reflect the options that countries have when designing their climate policy. Part (i) compare the cost of using only domestic instruments, i.e. as if the ETS option to close the gap was unavailable, and therefore assesses the potential value of the emissions trading option within the Nordic countries. Part (ii) provides information on how big a share of the burden could be allocated to the trading part of the economy if international "emission leakage" and large transitional cost due to structural changes are to be avoided. Part (iii) looks at effects of instruments applied simultaneously with the EU ETS on the trading sector. Part (iv) looks at the sectoral burden sharing within countries, i.e. the cost of using EU ETS to close the emissions gap when effects on non-trading sectors also are accounted for.

To evaluate the aggregate cost and structural effects of an economic policy that is likely to affect a relatively large part of the economy directly or indirectly, it is helpful to use a model that explicitly covers the whole economy. A widespread tool for this is a computable general equilibrium (CGE) model. Although these models, due to their "top-down" specification, often lack the detailed description of technologies often found in engineering type models, i.e. "bottom-up" models, they have the advantage of describing all transactions in the economy in a consistent way. The models explicitly take into account macroeconomic feedbacks, such as effects on trade, the labour market, and the government budget. "Bottom-up" models usually only cover part of the economy, e.g. the energy sector, which clearly makes them less suitable to quantify macroeconomic effects. Synthesis models which combine features of "bottom-up" and "top-down" models have also been developed and used for climate policy analysis. The majority the studies surveyed below are based on models belonging to either of these categories.

4.1 Aggregated economic effects of the EU ETS

If you want to compare the aggregate economic costs of instruments used in climate policy in absolute figures, the starting point for the analysis, commonly the projected business-as-usual (BAU) scenario ("with existing measures" scenario), is of great importance. The fact that different studies often use different assumptions in their BAU projections makes direct comparisons of absolute numbers difficult. That is, if the BAU yields a Kyoto gap of, for example, 5 or 10 percent clearly matters for the absolute cost of reaching the target. However, if you merely want to compare the rankings of different policy alternatives between studies or countries, the BAU projection is of somewhat less importance.

What does matter when analysing the aggregate economic effect of the EU ETS is the way the non-trading sectors are treated in the model. That is, if the Kyoto gap is closed by using the EU ETS combined with other measures on non trading sectors it is clearly so that the cost will depend on the distortions caused by the non-ETS measures which may be necessary to close the gap. This also makes analysis of the aggregate cost of emissions trading difficult to compare between studies unless the "burden sharing" of the Kyoto gap between the trading and non-trading sectors is similar in the assessments compared.

To compare aggregate economic effects of the EU ETS on the Nordic countries, it is helpful to look at results from multi-country models separate out these countries. We therefore start by presenting results of such studies and thereafter complement them with results from country specific studies.

EU wide studies

On assignment from the European Commission Capros and Mantoz (2000) analyse the cost to each Member State from reaching their burden sharing target 2010, with and without use of an European emissions trading system. The study mainly focuses on the trading system implemented alongside existing measures and, hence, does not assess the effect of interaction between the ETS and other instruments.

The calculations, carried out with the bottom-up type energy system model (PRIMES), show a marginal abatement cost within the EU in the year 2010 which on average is 54 Euro per tonne CO_2 if each Member State reaches its target by (optimal) domestic measures only (see table 4.1). In these calculations relatively large differences are shown among the Nordic countries. Given the rather low emission reduction requirements placed on Sweden in the burden sharing agreement, the marginal abatement cost (MAC) in Sweden is clearly below the EU average (although the projected emission increase is relatively high in the model). Finland on the other hand has a MAC that is among the highest in the EU which most likely is due to a relatively steeply increasing MAC and, especially, a large projected Kyoto gap. Denmark, on the other hand, is projected to have a low BAU emission increase relative to Sweden and Finland, which results in a Kyoto gap which in size is close to the Swedish gap.

According to the calculations, all Nordic countries would gain by participating in the emissions trading system relative to the use of an (optimal) unilateral policy, e.g. a domestic trading system covering all sectors.

Table 4.1 Aggregate cost of closing the Kyoto gap: Calculations with the PRIMES model

	Reference: "No ETS"		"EU ETS"	
	MAC (€/Mt)	Total cost (M€)	MAC (€/Mt)	Total cost (% relative reference)
Denmark	48	258	Non-ETS sector: 36 ETS sector: 33	-2.4
Finland	63	582	Non-ETS sector: 40 ETS sector: 33	-10.5
Sweden	40	131	Non-ETS sector: 36 ETS sector: 33	-5.9
EU15	54	9026	Non-ETS sector: 43 ETS sector: 33	-24.0

Source: Capros and Mantzos (2000).

Note: "No ETS" corresponds to a scenario where all countries reach their burden sharing target unilaterally with domestic emissions trading among all sectors, "EU ETS" is EU wide trading among energy supply and energy intensive industry. Values in Euro 1999.

Viguier et al. (2003) and Babiker et al. (2003) uses the MIT EPPA model, a recursively dynamic multi-regional CGE model of the world economy, to analyse the welfare cost of reaching the emission targets specified in EU's burden sharing agreement. The analysed scenarios do not directly correspond to the scenarios analysed by Capros and Mantzos (2000) but the results are, at least partly, consistent. Both studies find that the marginal abatement costs when the Member States achieve their burden sharing targets unilaterally differ substantially. This implies that there are potential gains from emissions trading, i.e. the cost of reaching the emissions target could be reduced both at union and at Member State level.

Starting from the BAU projections for 2010 the results indicate that Denmark, Sweden and especially Finland have relatively large potentials of low cost abatements (Viguier et al., 2003). On the other hand, the MIT EPPA model shows that the Nordic Member States all are among the countries with the highest marginal abatement cost. One reason for this is that the model projects BAU emissions to increase substantially more in the Nordic countries than in the EU on average. Denmark, Finland and Sweden need to reduce emissions by 43.4, 31.5 and 31.0 percent of their BAU 2010 emissions, respectively, to reach their burden sharing target level.[15] The corresponding number for EU is 19.7, and for the big emitters UK and Germany, 12.7 and 17.8 percent respectively. Another reason is the shape of the MAC curves. The Nordic countries MAC curves are relatively linear, indicating that emission reductions cost is increasing at a more constant rate (up to 30–40 percents reduction). Other countries have more convex MAC curves. For example, Germany has low abatement cost as long as emission reductions are below 20 percent relative to

[15] Note that these projections are "with existing measures" but includes decommissioning of nuclear power in Sweden. The Swedish BAU emissions appears to high relative to many other projections and highlights the importance of the assumed economic projections when comparing cost of reaching emission targets among countries.

their 2010 emissions, but higher marginal cost if emissions should be reduced further.

The welfare cost of reaching the burden sharing target, in the EPPA model defined as the extra income necessary to compensate the households for the losses caused by the policy change, varies among Member States from 0.6 to 5 percent of income in BAU projection. The cost to the Nordic Member States, especially Denmark and Sweden, are shown to be among the higher in EU. However, contrary to the results from the PRIMES model, Finland has a substantially lower cost than Denmark and Sweden. This is at least partly due to the positive terms-of-trade effects that the (policy induced) energy price reduction bring about. This effect is larger for Finland relative to the other Nordic countries. The PRIMES model, being a single region model, is unable to take such effects into account.

Country specific studies

The quantitative analysis of the EU burden sharing agreement and the EU ETS focus on the Member States and therefore does not explicitly include Norway. The assessment by the Norwegian governmental emissions trading commission (2000) found that the marginal abatement costs for GHG emission reductions are relatively high in Norway compared to most other countries. One reason for this is that power supply is hydro-based. Many other European countries such as the UK and Germany have considerable scope for low cost reductions in their power sectors. Furthermore, Norway has already imposed taxes on more than 50 percent of the total GHG emissions, particularly in those areas where the abatement costs are probably the lowest. This means, according to the commission, that a considerable part of the low cost potential is already exhausted.

The emissions trading commission presented two main scenarios based on calculations with MODAG, an econometric macroeconomic model, and MSG, a CGE model. One scenario assumes cost efficient fulfilment of the Kyoto obligations, including the use of the Kyoto mechanisms, and the other that the mechanisms are not used at all.[16] Assuming an international allowance price of NOK 125 for the period 2008–2012, the first scenario finds that slightly more than 5 million tonnes of CO_2 equivalents would be reduced at home, and the rest of the obligation (some 6 million tonnes) would be achieved using the Kyoto mechanisms. Some 4 million of the domestic reductions would be gases other than CO_2. Total costs for the Norwegian society would be around NOK 2 billion/year, of which half would be costs from using the Kyoto mechanisms.

[16] In both scenarios it is assumed that the crude oil producer price is reduced by 15-20 percent in 2010 compared to a situation without any climate agreement, implying a reduced real income for Norway of about NOK 15 – 20 billion in 2010. It is also assumed some increase in power prices in Norway and Europe up to 2010.

If all reductions are to be carried out at home, the other scenario shows that the overall CO_2 tax (or the overall domestic allowance price) would have to be around NOK 350/tonne in 2010 to fulfil the obligations. The revenue from this tax was assumed to be used to reduce other taxes, so that total tax revenue would be unchanged. Total costs for the society would be some NOK 6 billion/year or 0.5 percent of estimated GDP in 2010.

This clearly indicates that not using the Kyoto mechanisms would be very costly for Norway. Even modest restrictions on this use might imply high costs.

Some country specific studies of Finland and the use of the EU ETS have been carried out. Honkatukia (2004a) uses an economic-technical model of Finland, the “EV-model”, which combines technical “bottom-up” information on energy and industrial sectors with an economic “top-down” equilibrium model describing the Finnish economy. The model is used to analyse effects of the EU ETS on the Finnish economy in various scenarios and compared with a BAU scenario where only existing measures are used.

On the aggregate level it can be seen that depending on the EUA price level, 5–20 Euro per tonne, Finland’s GDP would decrease by 0.5–0.9 percent (assuming that the existing tax structure remains and scaled up for non-trading sectors in order to reach the emission reduction target). The assumed allocation to the trading sectors corresponds to a 19 percent reduction of their BAU emissions. As could be expected, low EUA prices would be least harmful for the economy as a whole. Among the scenarios analysed, the study indicate that the least costly way to fulfil the climate target would be to use a “wind-fall tax” on electricity production and recycle the revenues as subsidies to investment in nuclear and renewable electricity production. With such a policy the cost of reaching the emissions target would be a 0.7 percent GDP reduction.

Honkatukia (2004b) analyse the effect of sectoral differentiation of allowance allocation in Finland and finds that the differentiation has little or no effect on aggregate cost to the economy. What does matter for aggregate cost, however, is the amount of allowances distributed to the trading sector, i.e. the burden sharing between the trading and non-trading part of the economy. This is analysed by Honkatukia, Forsström and Tamminen (2003). Among other issues, they use the EV model and other bottom-up models to analyse two initial allocation plan scenarios. The conclusion is that the total amount of allocation does have a significant impact on aggregate economic cost and that an allocation which is based on emission levels resulting from an equalization of domestic marginal abatement costs would be significantly lower than an allocation (or burden sharing) based on the current differentiated energy tax system.

The effect on the Swedish economy of participating in the EU ETS has been assessed in several studies. The governmental FlexMex2 Commission (SOU 2003:60, SOU 2005:10, Östblom (2003)) used the EMEC model, a single country CGE model, to quantify the effect on the Swedish economy. Based on the domestic emission reduction target level, the study calculates the cost of reaching the current national emission target with or without the EU ETS and also assesses the use of a Swedish climate target in which emission reductions within the EU ETS are accounted for. As expected, the results show that participating in the ETS reduces cost compared with using only domestic instruments. Relative to BAU, GDP is reduced by 0.2 percent if emissions trading is used and the price of allowances is 30 USD/ton CO_2. The study also conclude that emissions trading may be less beneficial if Sweden maintains the current national target where emission reductions abroad (through the ETS) are not accounted for. The effect of maintaining the current policy, according to the study, is that a decrease in allowance price increases the cost of reaching the target.

Hill and Kriström (2002 and 2005) use CGE models over the Swedish economy to assess the effect of the EU ETS and the Swedish climate policy. In line with other studies, the model results indicate that the use of emissions trading is beneficial compared to using the current domestic instruments. However, the cost of reaching the climate target by participating in the EU ETS might not be lower than if an optimal domestic policy is used, due to the relatively low sectoral coverage of the EU ETS. Furthermore, the results are strongly dependent on the assumed EU allowance price, the effect on the electricity price and, especially, the amount of allowances allocated to the trading sectors. The lowest aggregate cost, given an allowance price of approximately 20 Euro/ton, is achieved by allowing the use of the ETS to reach the target and reduce the amount of emissions allowances that are allocated. This will alleviate some of the burden on the non-trading sector and therefore reduce the overall cost.

4.2 Effects on competitiveness

It is frequently noted that strict CO_2 policies will deteriorate the carbon intensive industry's competitiveness. In the debate, the competitiveness issue is used as an argument both for and against the use of emissions trading. Many proponents of emissions trading point to the ability of international ETS's to "level the playing field" in a way that would be difficult to achieve by using national policies. However, partial ETS's covering only some sectors and/or countries, will clearly not have this levelling ability and could therefore negatively affect the trading industries' competitiveness.

To begin with, it is important to note that competitiveness is not a well-defined term in economics. It is probably more fruitful to talk about changes in a country's comparative advantage. If a country or region unilaterally implements a strict CO_2 policy it will change the advantage of its CO_2-intensive industries toward less CO_2-intensive industries compared to other countries or regions with less strict policy. This would normally reduce the production within the CO_2-intensive industries and can therefore be viewed as a loss in competitiveness.

As was the case with the aggregate economic effects, comparing detailed results on sector specific competitiveness from different studies is not easily done, due to, for example, assumptions on BAU development of productivity etc at sector level. It is therefore often not fruitful to compare the exact numbers between different studies. However, the overall effect on industry level in different studies is interesting to compare.

The effect on a specific industry's competitiveness, e.g. measured as the effect of the EU ETS on the industry's value added and output level, is due to different factors. The most obvious is the industry's fossil fuels input share, the possibility to substitute from fossil fuels to other inputs, the amount of process emissions, and the possibility to pass on increased cost on prices. In addition, and possibly less obvious, is an industry's use of intermediate goods for which the cost increase is likely to be passed on, e.g. electricity.

Competitiveness has been analysed using different methods. The simplest methods look primarily at the data on emission intensity of different sectors and use these numbers to calculate the cost increase for a given allowance price. The indirect effect due to emissions trading induced electricity price increase could be added to the direct cost by using data on electricity intensity and calculate the cost increase for a given electricity price increase. These types of static calculations say something about especially the effects in the short run. A more complete picture could be given by analysing each sector's possibility to pass on increased cost on the product price, i.e. if the sectors have some sort of price setting power on its relevant market. In the case where the industry is competing on the world market it is less likely that it can pass on increased cost relative to the case where production is aimed for the domestic market. If, in addition, the industry's possibility to abate emissions, and its direct and indirect interaction with other parts of the economy, is assessed, a better estimate concerning the medium and long term effects could be obtained.

The International Energy Agency (Reinaud, 2005) assessed the effect on the energy intensive sectors within the EU ETS and the aluminium industry at the EU level. The study does not consider competitive distortions within the EU, it mainly calculates the static effect, e.g. disregarding abatement possibilities, on the average industry within EU. The assessment does take into consideration both the direct effect due to emission per unit produced, and the indirect effect due to electricity price increase. Given that the analysis disregards abatement opportunities, the estimated effects could be interpreted as an upper bound to the costs.

The study concludes that with a 10 Euro/ton allowance price and free allocation of allowances corresponding to 90 percent of the BAU emissions, the average cost increase from the ETS will be minor for the industries. The industry ETS sector with the largest impact is cement with an average cost increase corresponding to 3.4 percent. The aluminium industry will face an average cost increase of 3.7 percent due to electricity price increase. When considering price effect for the marginal product, a measure probably more relevant for competitiveness, aluminium face a cost increase corresponding to 53.1 percent, followed by blast furnace steel, cement, newsprint and electric furnace steel with a cost increase of 20.6, 8.7, 4.5, and 3.4 percent, respectively. This cost increase indicates that it could be a substantial effect on production levels in the medium to long run.

The effect on the Swedish industry's competitiveness due to the introduction of the EU ETS has been studied by the governmental agency The Swedish institute for Growth Policy Studies (ITPS, 2004). The study's main results, based on different approaches, e.g. so called Salter analysis and econometric model simulations, indicate that the Swedish industry may lose a significant part of its competitiveness and there will most likely be a restructuring of Swedish industry toward less energy intensive production. The use of free of charge allocation of allowances will not reduce the negative effect on competitiveness. Although the different approaches in the study give somewhat different results, the estimated impact on the Swedish industry does in large correspond to the findings in Reinaud (2005). The cement industry is hit hardest by the ETS, followed by the steel producers. Furthermore, the iron ore extraction as well as the chemical industry is negatively affected. The paper and pulp producers are less affected by the ETS, and the effect is primarily indirect through higher electricity prices. In addition, the study also points at a large cost increase for the refinery industry. Aluminium production is not shown separately in the results and therefore no conclusion is drawn concerning this sector.

The Swedish governmental FlexMex2 Commission analysed the effect of the EU ETS on different sectors using a CGE model with focus on the period 2008–12.[17] With an assumed EU allowance price of 30 USD/ton and a removal of the CO_2 tax on the trading sector the calculations find that impact on the ETS sectors differs with the largest negative effect on value added on refineries, and mining industry. Steel and metal and pulp and paper production is less effected by the trading system with a value added reduction of less than a percent compared with BAU. The relatively small effect on the steel and metal sector may be a result of model specification such as the assumption that the steel and metal producers have some price setting power on the world market and little or no

[17] SOU 2003:60, SOU 2005:10, Östblom (2003)

effect from the ETS on the Nordic electricity price. In addition, in the calculations process emissions are not covered by the ETS.

The results by the FlexMex2 Commission could be compared with those of Hill and Kriström (2005) that uses similar CGE model but model the Swedish industry as price takers at the world market. The model also considers Nordic electricity price changes due to the ETS as well as inclusion of process emissions in the trading system. The study finds that with a price close to 30 Euro/ton, beside the refinery industry, the Swedish steel and metal producers are hit hard by the ETS, while the electricity producers increase its value added significantly. The value added in pulp and paper industry, however, was found to be reduced only marginally.
The effect on the Finnish industry due to the introduction of the EU ETS has been described by e.g. Honkatukia (2004a & b), Honkatukia, Kemppi and Rajala (2003).

Honkatukia (2004a & b) uses the EV-model to analyse effects of different EUA price levels, energy tax design, allocation rules, and different assumptions regarding the world market prices. In general, all results indicate that the Finnish metal producers are hit relatively hard with a reduced production level corresponding to approximately 15 percent of the BAU level if the EUA price is 20 Euro/ton and the world market prices are unaffected by the ETS. With the same assumptions, refineries and the pulp and paper industry are also negatively affected and reduce production levels by approximately 8 and 6 percent, respectively. As could be expected from economic theory, the results indicate that the production level reductions will not change much when allocation is redistributed between sectors. On the other hand, the relatively large negative effects are dependent on the in many instances plausible assumption that world market prices will be unaffected by the EU ETS. When these assumptions are relaxed and world market prices are assumed to follow the Finnish producers' cost increase to some extent, the negative effect on production level is reduced to more than half for the export intensive industries.

Honkatukia, Kemppi and Rajala (2003) look explicitly on the competitiveness effect of emissions trading and of partial auctioning of allowances are assessed. Static cost impacts are calculated, i.e. the direct cost increase due to the EU ETS is estimated from official industry statistics, disregarding intersectoral effects. The findings are that the direct effect on marginal cost is relatively low for all trading sectors except electricity and heat production. A 20 Euro/ton allowance price increases marginal cost in district heating and electricity production by more than 19 and 10 percent respectively, and by 2.5, 2.3 and 1.1 percent in the metal industry, refineries and the paper and pulp industry, respectively. Average cost changes is relatively small in all sectors, less than 1 percent in average. However, this cost is obviously affected by if allowances are allocated for free or auctioned. The relative small direct effects on marginal cost from the EU ETS shown in this study, and the relative large effects on production level in the model simulations found in other studies, indicate that it is crucial to take intersectoral effects as well as effects on world market prices into consideration when competitiveness is analysed.

In Norway the emissions trading commission (2000) analysed potential consequences for the most emission intensive industries from an emissions trading system. The detailed analysis comprised the petroleum industry, parts of the land based industry (mainly the power intensive industries), the transport sectors and fisheries. It was assumed that a broad emissions trading system for 2008–2012 was established, covering some 80–90 percent of all Norwegian GHG emissions. To reduce negative impacts for the most affected industries, it was assumed that a share of the allowances was allocated free of charge to them, and the effects on profitability of various percentage shares of free of charge allocation was analysed.

If the Norwegian emissions trading system follow the EU ETS design and sectoral coverage, analysing the direct consequences for some of the most emission intensive industries (aluminium, ferroalloys etc.) from an emissions trading scheme may not be so relevant. Although not directly relevant for the EU ETS, the main results of the abovementioned analysis provide some information of the vulnerability of the Norwegian industries to emissions trading.

The oil and gas extraction industry on the continental shelf, which is not included in the ETS today, paid a CO_2-tax of NOK 289 per ton CO_2 in 2000.[18] If this tax was replaced by emissions trading, and the sector would have to buy all its allowances, there would be a substantial gross benefit for the sector according to the emissions trading commission. The CO_2 tax has spurred several emission reduction measures.[19] Replacing the tax with an emissions trading system would most likely imply a reduction of the "price" on CO_2 paid by the oil companies, and thus that fewer abatement measures would be profitable to implement.[20] The competitiveness would therefore not be impaired if Norway follows the current policy avoiding using tax and emissions trading on the same sector.

The calculations also conclude that an ETS could potentially have large negative effects on the aluminium plants, the ferroalloys plants and the cement producers. The aluminium plants will mostly be affected by the ETS induced electricity price increase and less by the direct cost of buying allowances. The ferroalloys plants will be negatively affected by

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[18] In 2005 this tax is increased to NOK 333/ton CO2.

[19] See ECON (1998)

[20] According to the emissions trading commission (2000) emissions from this sector could in fact increase over time because of this. ECON (1998) shows that in 2010, 80 percent of the emissions will stem from fields that were already in operation or where the construction plans were so far developed that major changes were not an option. For the new fields accounting for 20 percent of the emissions, technological changes would be possible, and lower CO2 prices could potentially have effects on these emissions.

the both the electricity price increase and the cost of allowances. The cement producers, on the other hand, will mostly be affected by the direct cost of buying allowances to cover their emissions. All these industries would most likely be unable to pass on a large cost increase on the product price due to substantial international competition. The cement producers may however be able to increase prices in the short run before relocation of production capacity could occur.

In the study, the Norwegian petrochemical industry and the oil refineries are found to be less affected by the ETS. There will however be negative effects due to process emissions in these sectors. The refineries could most likely pass on some or all of the increased cost on the product price. The Norwegian pulp and paper and fishmeal and fish oil industries mainly pay a CO_2 tax of around NOK 100/ton on the fuel oil use. Replacing the CO_2 tax with an emissions trading system would, according to the emissions trading commission not seriously affect the competitive situation of these industries even if they would have to buy all the allowances.

The Danish Energy Authority briefly assessed the potential effects on Danish industry covered by the EU ETS.[21] The study was not model based and did not analyse the energy intensity or the cost potential increase due to the ETS. It solely focused on identifying the relevant product and geographical market for the industries and the potential competition within and outside the EU ETS. This, of course, will at the best give an indication of the sectors potential for “passing on cost” to the product price but does not say anything about the cost and it is therefore difficult to draw conclusions about the effect of the ETS based on the study. The findings are that especially the Danish chemical industry is the sector that currently faces most competition from outside EU, while competitors to the stone, clay and glass industries mainly are found within EU.

4.3 EU ETS and other instruments

In chapter 3 some theoretical issues concerning the use of multiple instruments where discussed. The general conclusion was that, from an economic and environmental effectiveness point of view, it is often difficult to justify the use of other climate policy related instruments than emissions trading in the sectors that are covered by the ETS.

Surveys of the use of multiple instruments, such as the case studies carried out within the European Commission funded INTERACT project[22], indicate that overlapping use of ETS and other instruments in many European countries could potentially have negative effects on the efficiency of climate policy. However, relatively few studies attempt to

[21] Copenhagen Economics (2003)

[22] The INTERACT project, funded in part by the European Commission, was conducted between 2001 and 2003 (see Sorrell, 2003).

quantify the effects on the cost of environmental policy. One reason for this might be the relative complex interactions that are at play. Accordingly there are few quantitative studies examining the interaction between emissions trading and other instruments in the Nordic countries.

Honkatukia, Forsström and Tamminen (2003) study the effect of energy taxation and the EU ETS. By using three different models, two bottom-up energy market models and one synthesis model (the EV-model), they study a range of scenarios and take into consideration issues such as the use of different "compensating" tax instruments to keep aggregate tax revenues constant, and assess the effect of different allocations schemes for trading and non-trading sectors.

Starting with assuming different allowance prices and allocation schemes, three different tax scenarios are assessed; (i) Keep existing energy taxation on the trading sector (but increase the tax on non-trading sectors to reach emission target), (ii) remove all energy taxes on the trading sector (but increase the tax on non-trading sectors to reach emission target) and use the income tax to replace the revenues lost, (iii) Fuel taxes are removed from the trading sectors (but increase the tax on non-trading sectors to reach emission target) and the electricity taxes are scaled up (on all sectors) to cover revenue losses.

The results indicate that in terms of loss in GDP it would be most costly to remove all energy taxes on the trading sector (scenario "i"). The other two scenarios are approximately equally costly, i.e. removing the fuel taxes on the trading sector to avoid "double taxation" appears to have relatively little effect on aggregate cost. It is also interesting to note that the aggregate effect of reduced taxation on trading sectors is relatively small compared to e.g. changes in the allocated amount of allowances, which is discussed in the next sub-section.

The changed taxation may of course induce distributive effects that may substantially affect a specific sector, although not change aggregate cost in a major way. Furthermore, changed energy taxation will affect the marginal cost and therefore have an influence on competitiveness. The abovementioned Swedish study by ITPS (2004) show that maintaining the Swedish CO_2 tax will affect the trading sectors competitiveness in a non-negligible way, albeit with large variation between sectors, which partly is due to the existing tax reductions for some sectors. Especially the iron and steel, the iron ore extraction, and the paper and pulp industries will be affected by the removal of the CO_2 tax.

Hill and Kriström (2005) assess the effect of maintaining the current level of CO_2 tax on the trading sector in Sweden. The study finds that it would improve welfare to remove the tax although the aggregate effect of the tax is modest given its current level. One reason for this is that the tax, in the model, is replaced by an increase in the payroll tax to make the tax removal income neutral. This means that the distortion that was caused by the CO_2 tax will be replaced by increased distortions from the payroll tax, hence reducing the potential efficiency gain. However, it is noted that the effect of removing the CO_2 tax will have little or no environmental effect as CO_2 emissions within the EU cap would clearly be unaffected. It is therefore difficult to argue for the maintaining of the tax on sectors included in the EU ETS.

As was noted in chapter 3, trade in green certificates is likely to interact with an ETS that includes carbon emissions from electricity generation. Although, green certificate systems are already operating in the Nordic electricity market (i.e. in Sweden) there is little quantitative analysis of the presumably complex interacting effects with the EU ETS. Hindsberger et.al (2003) uses a numerical bottom-up model of the Baltic sea region (including Norway) electricity market to analyse the interaction between a hypothetical emissions trading market within the Nordic countries and green certificate trading among Denmark, Finland, Sweden and Germany. In addition, the studied emissions trading bubble is separate for the electricity market. The hypothetical system differs from the EU ETS in several ways, which makes it difficult to transfer the results to the current situation. Nevertheless, among the results, the study numerically shows that the price of CO_2 allowances is negatively related to the quota requirement from the green certificate system, which clearly could be expected from theory. Reduction in the emissions trading cap does, however, not have any significant effect on the price of green certificates.

4.4 Effects on non-trading sectors

In the first commitment period 2008–2012, i.e. phase II of the EU ETS, the use of emissions trading and/or other Kyoto mechanisms will, contrary to phase I, directly affect the non-trading sector.[23] Less strict allocation of allowances and/or less use of credits from JI and CDM projects will inevitably place a larger burden on the non-trading sector. To the policy maker it is of course important to know the optimal use of each instrument/mechanism. The optimal burden sharing depends on the relative price of EUAs, credits from JI and CDM, as well as the relative MAC and shape of MAC curves. In the case of governmental purchase programs of JI and CDM credits, the cost to society of raising public funds for this purpose should also be considered.

It is clearly difficult to take all these different effects into consideration when studying these issues. CGE models could in principle be used to study the optimal balance of instruments and mechanisms, albeit often in a relative crude way.

In the previously discussed study by Honkatukia, Forsström and Tamminen (2003) the cost of allocating a relatively large amount of allowances to the trading sector is discussed. A more generous allocation

[23] See section 5.2.

implies that the CO_2 tax on the non-trading sector has to be increased more than if the allocation is less generous (given that Finland's climate commitment should be fulfilled). According to the study, lower allocation to the trading sector will result in lower aggregate cost. That is, using more EU ETS when achieving the commitment reduces cost through reducing the burden on the non-trading sector. In the Finnish study, assuming 20 Euro per ton, giving the trading sector allowances corresponding to approximately 88 percent of its BAU emissions yields a tax increase on the non-trading sector corresponding to 164–169 percent of the existing level. If instead the trading sectors are allocated approximately 84 percent of its BAU emissions the tax on non-trading sectors could be reduced by 5–9 percent.

The different marginal burden put on the non-trading sector has implications for the overall cost. The study shows that with assumed EUA prices of 10 or 20 Euro/ton CO_2 a more generous allocation to the trading sectors will increase the overall cost to the economy.[24] However, with a higher price of allowances, the decrease in overall cost of increased allocation is lower. That is, the relative advantage of using the ETS when closing the Kyoto gap is reduced when the price of EUAs is increased.

The abovementioned results are congruent with the results found by Hill and Kriström (2005) using a CGE model to analyse the effect of the EU ETS effects on the Swedish economy. With an assumed EUA price of approximately 16 Euro/ton CO_2, increased allocation, within the range considered, will increase overall cost for Sweden to reach the national target.[25] This result stems from the differentiated tax rates used in the BAU projection (i.e. today's tax level) where the trading sectors are levied a reduced rate relative to the non-trading sector. With a generous allocation, the differences in marginal abatement cost present at the benchmark will increase when a larger emission reduction requirement are placed on the non-trading sectors. The spread in MAC indicate that potential welfare improvements could be realized by redistributing the burden toward the trading sector. However, these results are to a large extent driven by the assumed EUA price and also sensitive to the technology specification in the model. Increased EUA price and/or a relatively steeper MAC curve will make such redistribution less attractive.

The two abovementioned studies indicate that when deciding on how many allowances to allocate to the trading sector, it is important to consider the relative cost of emission reduction in the non-trading sector. The fact that energy intensive sectors often have reduced fossil fuel tax rates

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[24] The study considers two different allocations to the trading sector, one which is 5.1 Mt lower than BAU emissions and one which is 6.5 Mt lower. These allocations imply that the non-trading sector should reduce its emissions by 2.3 and 0.9 Mt, respectively.

[25] This assumes that Sweden uses a national target where imported allowances are counted toward the targets fulfilment, i.e. assuming Sweden changes the current target which only counts domestic emission reductions. If the current target formulation is maintained the effect will be the opposite, i.e. increased allocation will lower aggregate cost somewhat.

indicate that the non-trading part of the economy in large have relatively higher marginal cost and that further reductions in these sectors might be costly, i.e. that a large part of the “low-hanging fruit” may have been used already. Bruvoll and Larsen (2004) find that the Norwegian CO_2 tax, which to a large extent is exempted in the EU ETS trading sectors, had little effect on emissions in the period between 1990 and 1999. According to their CGE model results, the sectors levied a CO_2 tax had relatively inelastic fossil fuel demand. This indicates that increased abatement in the non-trading sector might be relatively costly, and therefore lower allocation and/or increased use of the other mechanisms may be a better option.

4.5 Summary and conclusions

This section has summarized results from a number of quantitative studies assessing emissions trading and the effects on the Nordic countries. Although the results from the different studies, for several reasons, are difficult to compare some more general conclusions can be drawn.

Firstly, on aggregate national level the use of international emissions trading in general is beneficial compared with fully domestic policies. Clearly, by realising the potential gains from trade aggregate cost will not increase in any country. This conclusion does not necessarily hold when analysing the effect of EU ETS that only covers part of the economy. The realized gain to a country through the EU ETS relative only using well designed domestic measures is highly dependent on the number of allowances allocated to the trading sectors and also on the price of allowances. With an incorrectly balanced burden sharing between the trading and non-trading sector the use of EU ETS might be inferior from an aggregate cost perspective relative to the use of domestic measures only. Furthermore, the chosen allocation method, e.g. auctioning, partial auctioning or free of charge allocation, does not in any significant way seem to affect the aggregate cost of emissions trading.

The Nordic countries appear to have relatively high marginal abatement cost today. This may, however, not be a good indicator of how costly large emission reduction will be. What also matters is the shape of the MAC curve. For example, some countries such as Germany have, according to some calculations, relatively low marginal abatement cost today but the when the “low hanging fruit” is used further reductions will be much more expensive which means a steeply increasing MAC when abatement reaches a certain level. The Nordic countries, on the other hand, are found to have more constant rate of increase in marginal abatement cost.

The second conclusion concerns the competitiveness of the energy intensive industry. This issue has been given a lot of attention in the debate, and the concern for these potentially negative effects has not decreased since the EU ETS was launched. The quantitative studies give some support to these worries. Some sectors are more seriously negatively affected by the ETS, although the results depend to some extent on the model used for calculations, or more correctly, it depend on if the assessments focus on the marginal or average cost effects. In studies focusing on the cost increase of the last unit produced, the effect on competitiveness is often more severe than if the focus is on the average cost increase. When looking at the marginal cost it does not matter much if the allowances are handed out for free as the effect depends on the market value of the allowances. Average cost calculations, on the other hand, often finds a substantially larger effect depending on if allowances are free or auctioned. In the longer term, however, the focus on marginal cost is probably a more correct indicator of companies' decision on the optimal production level. In addition, secondary effects through increased electricity prices will be very important.

In general the assessments find loss of competitiveness in the energy intensive sectors competing on the world market. Steel and metal producers and the cement producers will face a large cost increase directly due to the ETS, while other sectors, primarily aluminium and pulp and paper, will mostly be affected indirectly through higher electricity prices.

A third and possibly the most important observation is that the balance between the use of the ETS and the burden on the non-trading sectors is very important for the overall cost. The prevailing spread in marginal abatement cost between trading and non-trading sectors found in the Nordic countries due to CO_2 tax exemptions on energy intensive sectors indicate that less generous allocation, i.e. more use of emissions trading, could reduce overall cost. However, it should not be disregarded that the optimal use of the EU ETS depends on the future allowance price and the relative shape of the marginal abatement cost curves in the non-trading sector, which still are surrounded by large uncertainties.

5. The introduction of emissions trading

In this chapter we discuss the introduction of emissions trading in the Nordic countries. In 5.1, we present the main features of emissions trading in the period 2005–2007, especially how the Nordic countries have allocated emission allowances, and how the market for emissions allowances has developed so far. In 5.2, we discuss how the conditions for the EU ETS might change in the period 2008–2012.

5.1 Emissions trading 2005–2007

As EU Member States, Denmark, Finland and Sweden were obliged to implement the EU ETS. Norway has developed a domestic emissions trading scheme, which shadows, and most likely will be connected to, the EU ETS, whereas Iceland neither takes part in the EU ETS nor has a national emissions trading scheme.

5.1.1 Features of emissions trading in the Nordic countries

As was mentioned in chapter 1, the EU ETS in total covers approximately 12 000 installations. The total allocation to these installations, amount to approximately 6.5 billion tonnes of CO_2 for the period 2005–2007, i.e. approximately 2.2 billion tonnes as a yearly average.

Together the Nordic countries stand for approximately 13 percent of the total number of installations of the EU ETS, but less than 5 percent of the total allocation. The number of installations, the allocation, and other main elements of how emissions trading have been implemented in the Nordic countries in 2005–2007, are summarized in table 5.1 below.

Some explanatory comments about why the scope of emissions trading varies between the Nordic countries are given in direct connection to the table. In the rest of section 5.1.1, we discuss the allocation of emission allowances more in detail, since it has been a central part of the implementation of the EU ETS.

Table 5.1 Main elements in the introduction of emissions trading in the Nordic countries 2005–2007

	Denmark	Finland	Norway[1]	Sweden
Trading sector's share of emissions[2]	60 % of CO_2 emissions, 47 % of all GHG emissions	71 % of CO_2 emissions, 60 % of all GHG emissions	16 % of CO_2 emissions, 13 % of all GHG emissions	42 % of CO_2 emissions, 33 % of all GHG emissions
Number of installations covered, (approx.)	350	550	50	700
Total allocation, yearly average 2005–2007[3]	33.5 million tonnes	45.5 million tonnes	6.8 million tonnes	22.9 million tonnes
Allocation compared to recent emissions	Power and heat production: 96 % of 2002 emissions Others: 110 % of 2002 emissions	Power and heat production: 105 % of average emissions 1998–2002/2000–2003 Others: 119 % of average emissions 1998–2002	Power and heat production: 95 % of average emissions 1998–2001 Others: 95 % of average emissions 1998–2001	Power and heat production: 80 % of average emissions 1998–2001 Others: 100 % of average emissions 1998–2001. 100 % of projected process emissions.
Auctioning	Yes, 5 % of total allocation	No	No	No
Opt-in/Opt-out	No/No	Yes/No	No/"Yes"*	Yes/No
Allocation method for existing installations (base years)	Grandfathering (1998–2002)	Grandfathering (1998–2002 on general, 2000–2003 for condensate power plants)	Grandfathering (1998–2001) or expected emissions	Grandfathering (1998–2001)
Allocation method for new entrants	Benchmarking	Benchmarking	Based on expected CO_2 emissions	Benchmarking

Notes: [1]) Refers to Norway's national ETS, which will probably be connected to the EU ETS. [2]) The share is calculated as 'Total allocation, yearly average 2005–2007' in relation to the yearly average for total emissions in the years 1999–2003 (as shown in table 2.2). [3]) For comparisons sake allocation is shown as yearly averages in the table. It should be noted, however, that the Member States do not have to issue the allowances to the concerned installations in equal portions every year. Thus, the directive only states that "a proportion of the total quantity of allowances" shall be issued each year. *) Norway has chosen a trading regime in which emissions from burning of fossil fuels that are subject to CO_2 tax is exempted from the regime. This could perhaps be described as an "opt-out", and is the main reason why the Norwegian ETS is of relatively limited scope.

The fact that the EU ETS covers a bigger share of emissions in Denmark and Finland than in Sweden can mainly be explained by the structure of the countries' energy sectors. Thus, in Denmark and Finland fossil-fuelled power production is common, whereas Swedish power production to a large extent is based on hydropower and nuclear power.

The main reason why there are more installations covered by the EU ETS in Sweden and Finland than in Denmark, is that both Sweden and Finland have chosen to include combustion installations with a capacity below 20 MW, which are part of a district heating system, in the trading scheme. In Sweden, such inclusion is done if the total installed capacity of the district heating network amounts to at least 20 MW, in Finland it is done if at least one boiler in the network is above 20 MW. These are, by the way, the only cases of use of opt-in by the Nordic countries in 2005–2007. Thus, Denmark does not use opt-in in the first period.

That the Norwegian ETS is of relatively limited scope, can be explained both by the fact that Norway's power production almost exclusively is based on hydro power (in Norway, also heating to a large extent is based on electricity), and that Norway has chosen a trading regime in which emissions from burning of fossil fuels that are subject to CO_2 tax is exempted from the regime. In practice, this means that around 67 percent of Norway's total allocation is connected to petroleum related industries, i.e. gas power plants, gas terminals, refineries and petrochemicals.

The process of allocation

Emission allowances constitute the commodity that is traded within the EU ETS. One allowance gives the holder the right to emit one tonne of carbon dioxide equivalent during a specified period.

A central part of the implementation of the EU ETS has been the allocation of these allowances to the operators of the concerned installations. The allocation follows a process in which each Member State develop a National Allocation Plan (NAP), which is then subject to approval by the European Commission. Based on the Commission's decision, the final allocation is then decided by the Member State. To administer the final allocation some countries (e.g. Sweden) also have, within the scope of the Commission's decision, introduced a process in which the installations concerned have to apply for allocation of allowances.

The NAP shows the total quantity of allowances that the Member State intends to allocate for the period in concern (2005–2007, 2008–2012, etc.) and the intended allocation of those allowances to the operator of each installation. The NAP shall include a list of the concerned installations. According to the directive, the plan shall be based on objective and transparent criteria, including those listed in Annex III to the directive, taking due account of comments from the public. Annex III states, for instance, that the total quantity of allowances to be allocated shall be consistent with the Member State's obligation to limit its emissions according to the EU burden sharing agreement and the Kyoto Protocol, taking into account, on the one hand, the proportion of overall emissions that these allowances represent in comparison with emissions from sources not covered by the directive and, on the other hand, national energy policies, and should be consistent with the national climate change programme. Prior to 2008, the quantity shall be consistent with a path towards achieving or over-achieving each Member State's target under the EU burden sharing agreement and the Kyoto Protocol. The total quantity of allowances to be allocated shall also be consistent with assessments of actual and projected progress towards fulfilling the required emission's targets. Some other examples of the criteria listed in Annex III are that the quantities of allowances to be allocated shall be consistent with the potential, including the technological potential, of activities covered by the trading scheme to reduce emissions, that the NAP shall be consistent with other Community legislative and policy instruments, and that the plan shall not discriminate between companies or sectors in a way that may distort competition.

Whether the total allocation numbers shown in table 5.1 indicate a generous or tight allocation is not easy to say just by studying the NAPs, especially not on lower levels of aggregation. Take for instance – just for the sake of illustration – the Danish NAP. On the one hand, the Danish NAP says that the allocated amount is 15 percent lower than business-as-usual projections of emissions from the concerned installations in 2005–2007, with the largest reduction of quotas compared to business-as-usual projections coming in the energy sector. On the other hand, the Danish NAP shows that the yearly average amount allocated to existing installations in 2005–2007 is more or less equal to their emissions in 2002. Another example can be taken from the Finnish NAP, in which the allocated amount is said to be five percent less than the predicted need based on a review by each sector, while on the other hand the allocation in most sectors are higher than the average emissions in 1998–2002. Of course, there is nothing contradictory in these examples per se. However, on general there seems to be a tendency that the NAPs at least not give excessively clear information on whether the allocation is generous or tight.

As was mentioned in chapter 1, the directive states that Member States shall allocate most of the allowances free of charge (at least 95 percent for the period 2005–2007 and at least 90 percent for the period 2008–2012). Of the Nordic countries, only Denmark has chosen not to allocate all allowances free of charge for the period 2005–2007. Thus, the Danish NAP states that a pool of 5 percent of the total amount of allocated allowances will be set aside for sale by auction during the period 2005–2007.

Allocation principles for existing installations

As is shown in table 5.1, Denmark, Finland and Sweden have solely used grandfathering as their method for the allocation of allowances free of charge to existing installations. Thus, some sort of historic activity has been the starting point for calculating the amount of allowances to be allocated to different sectors and installations. The most commonly used historic activity has been the sector's or installation's emissions. However, there are examples of other sort of activities being used as well, e.g. production numbers or combinations of different activities. All countries have used data from a period of years in recent "history", e.g. 1998–2002. In some cases, though, these data have been modified so as to be more representative. In the Finnish NAP, for instance, fuel consumption figures from energy installations used for district heating where modified in order to attain a better correspondence to the long-term average temperature.

Also in Norway, grandfathering has been the main principle for allocation to existing installation, with 1998–2001 as base years. However, if the emissions from an installation were expected to change significantly after 1 January 2001, due to significant changes in size or character of the concerned activity, the "grandfathered" allocation could be increased or decreased. This is the reason why table 5.1 states 'grandfathering or expected emissions' as allocation method for existing Norwegian installations. In practice, quite a large proportion of the Norwegian allocation has been based on expected emissions. It should also be noted that Norway has a rule according to which total allocation on installation level first is decided as a frame for the whole period, but in which the yearly issuing of allowances is optional pending a yearly decision by the concerned agency.

Table 5.1 shows that Denmark, Finland and Sweden all have made some notable differences in the treatment of different sectors in the NAPs, whereas Norway has opted for an explicitly equal treatment, as the Norwegian emissions trading law states that plants should be allocated allowances covering 95 percent of average emissions during 1998–2001. The differences between sectors in Denmark, Finland and Sweden can be described in the following fashion:

- *Denmark*: The sub-sector Electricity production was allocated the remainder of the allowances, after allocation to the sub-sectors Heat production and Other ETS industries, had been set in accordance with their respective emissions in 1998–2002. This seems to have led to a less favourable allocation to Electricity production.
- *Finland:* On general, 1998–2002 were used as base years for grandfathering, but for condensate power plants the years 2000–2003 were used instead. The reason is that 2000–2003 is said to have been more representative for condensate power plants than 1998–2002, regarding temperature and Nordic hydropower production.
- *Sweden:* The allocation for raw-material related emissions amounted to 100 percent of average emissions 1998–2001 plus a supplement in order to give room for expansion. The supplement corresponds to the projected increase in raw-material related emissions for the installation during 2005–2007. The energy sector was treated in another fashion. Thus, the allocation to combustion installations in the energy sector (i.e. installations whose main activity consists of production of electricity and/or district heating) amounted to 80 percent of average emissions 1998–2001. The reason, according to the Government, is that the potential to reduce emissions is higher for fuel-based than for raw-material related emissions and that the energy sector in contrast to the industrial sectors has not been exposed to competition from outside the EU.

Allocation principles for new entrants

The Nordic countries have on general set aside a reserve of approximately 2–3 percent of the total allocation of allowances for allocation to new entrants.[26] Denmark, Finland and Sweden have all developed benchmarks that are used as basis for the allocation to new entrants, whereas Norway intend to base allocation to new plants on expected CO_2 emissions for the years 2005–2007.

The benchmarks used by Denmark, Finland and Sweden are of various nature. In principle, it can be said that Denmark uses one model, and Finland and Sweden another, in the following fashion:

- *Denmark, based on emissions data from existing installations.* The general principle applied for allocation is that, for each of the activities specified in Annex I of the directive, an average CO_2 allocation is calculated per production capacity for the installations that produced during the base years (1998–2002). The calculation is made at the branch level for each of the activities. The allowance allocation to a new entrant is then calculated by multiplying the installation's capacity or capacity expansion with the sector average. According to the Danish NAP, it may be assumed that a new installation is more energy-efficient than the branch average, and therefore the calculation is reduced with a roughly estimated efficiency factor of 0.9.
- *Finland and Sweden, based on the possible performance from a new plant.* On sector level, and when considered possible, different benchmarks have been decided on the basis of what kind of performance could be expected from a new installation. In Sweden, for instance, benchmarks have been considered as possible to apply for combustion installations that produce electricity, district heating and/or steam. Where benchmarks are not available, best available technology serve as the basis for allocation of allowances to new Swedish installations.

The pool of allowances intended for new entrants, is generally administered on a "first come, first served" basis, i.e. when the allowances in the pool are finished, any new coming applicant is instead forced to buy its allowances on the market. It should be noted that the conditions for the benchmarking hereby are different than in a situation where benchmarking is used to allocate allowances within a group of existing installations. An activity in which benchmarking is used for allocation between a group of existing installations, e.g. as a way of making a NAP, could be described as an instantaneous division of a given amount of allowances (i.e. a fortune) between a given set of installations, with regards to, for in-

[26] It should be noted, though, that in the Swedish NAP almost 8 % of the allocation was set aside for new entrants. However, less than half of this was intended for "genuine", unknown new entrants.

stance, their relative emission efficiency. If in this case, as is to be expected, the total amount of allowances to be allocated is lower than the need of the concerned installations, a situation with clear winners and losers within the group momentarily occurs. It is not unlikely that such an allocation method would be harder to accept for the concerned stakeholders, than the sort of benchmarking as grounds for allocation to new entrants that is used by some of the Nordic countries (in which the winners and losers don't appear at the same time; rather, they can be defined as "early" and "late" applicants).

5.1.2 The market development so far

A European carbon market has been in existence for several years, although the EU ETS did not start until 2005. Forwards on EU ETS allowances were traded long before the start of the EU ETS. In 2005, however, trading has naturally intensified, and spot trading has also been established. Apart from bilateral trading, at least five fully functioning market places for emissions trading have been established in Europe, one of them being Nord Pool.

During 2005 the market price of allowances has fluctuated quite a lot, from a low of close to 6 Euro per tonne in February 2005 to a high of 29 Euro per tonne in July (see figure 5.1). At present (mid March 2006) spot prices hover around 26 Euro per tonne.

Figure 5.1 Price development of EU allowances (Euro/t CO_2)

Source: Point Carbon

According to estimates by Point Carbon, the total transaction volume on the European emissions trading market amounted to roughly 360 Mt CO_2 in 2005. In other words, approximately 15 percent of the total amount of allocated allowances was traded during the year. The most active market operators seem to be companies from the energy sector, whereas other industries so far have been less active.

Price setting factors

Needless to say, one of the crucial variables when policy makers decide on how much emission reductions a country achieve through the EU ETS is the estimated price of allowances. Price setting in the ETS clearly depends on the gap between the emission cap[27] and baseline emissions, i.e. the emission level without emissions trading, and the cost of closing the gap. Although there are annual compliance dates set, it is possible to borrow from next year's allowances in order to comply with the target. Hence, the balance over the entire trading period determines the price. Installations wishing to emit more CO_2 than their allowances permit, can buy allowances in the market. The supply of allowances comes from installations that submit less CO_2 than their allowances permit. Most installations have costs to reduce emissions: Either because production must be reduced, more expensive production methods have to be used or because investments have to be made in order to produce less carbon-intensively.

[27] That is, the total amount of allowances including allowances that stem from import of credits from CDM and JI projects.

The factors of high importance for the allowance price development within the short and medium term, beside the number of allowances allocated, is likely to be the relative fossil fuel prices, weather conditions, the economic growth rate, and the possibility to import and use credits from CDM and JI projects.

The National Allocation Plans

In the first 6–8 months of the EU ETS, some NAPs were still pending. This created uncertainty in the market and affected price formation. More generous allocation plans obviously increase supply and reduces prices. The regulations regarding reserves for new entrants and what happens to allowances if installations are closed are also important price-affecting features of the NAPs. The cap set by the NAPs and the Business-as-usual emissions, i.e. in a scenario without a cap, determines the "gap", i.e. the demand for emission reductions (or imports) in the system. In its review of the NAPs the Commission reduced the total allocation for several countries, and the allocation became lower than many expected, which have contributed to higher prices for allowances.

Gas prices and coal prices

Relative fuel prices to a large extent determine abatement costs in the ETS sectors. In the first trading period, the majority of emission reductions have to be realized in the electricity sector and by switching from coal generation to gas generation. The higher the gas/coal price ratio, the higher the carbon price must be to induce such shifts. During 2005 gas prices have increased considerably, while coal prices have been reduced, which have had a significant effect on the possibilities for fuel switching.

Industrial production levels

The activity level in the ETS industries affects the carbon market in several ways. These industries have direct emissions from their industrial processes, but also through use of energy sources such as gas and oil. In addition, they are often large consumers of electricity. Hence, the industries are affected by the carbon market through their position in the carbon market and through the carbon market's effect on power prices. On the other hand, if an industrial installation is adversely affected by high electricity prices and for that reason chooses to reduce or close production, this may also have a double effect on the carbon market: the direct emissions are reduced, and the industry's demand for electricity is reduced. During 2005 steel production in Europe has for instance fallen by about 4 percent, which could roughly correspond to about 8–10 Mt in reduced CO_2 emissions.

Weather conditions

Weather conditions affect electricity and heat markets. Warmer and wetter conditions than normal implies reduced electricity and heat demand (although electricity demand may increase in hot summers), and hence reduced demand for allowances. The autumn of 2005 was quite wet in the Nordic area, with a precipitation of 40 TWh above normal. This reduces CO_2 emission with about 40 Mt. On the other hand, Spain had a dry year in 2005, which leads to less hydro and nuclear production, increasing CO_2 emissions by about 20 Mt.

Economic growth

Increased economic growth means increased demand for goods and services, including energy and more installations will wish to increase their production (or have to be paid more to reduce production) and this would increase the emission gap.

Imports of allowances

In the period 2005–2007, imports to the EU ETS are permitted in the form of CDM credits from projects in countries without a binding commitment. Import of CDM credits may not have been expected to play a substantial role in the first trading period, partly because the process in developing projects and registers has been slow, and partly because CDM credits could be saved and were expected to be higher valued in the second trading period (2008–2012). However, the (relative many beforehand assessments) unexpectedly high allowance prices currently prevailing in the market may constitute a powerful incentive to speed up the process.

5.2 Emissions trading in 2008–2012

In this section we analyze what changes might possibly occur in the EU ETS framework in 2008–2012 (5.2.1), and the relation between the EU ETS and the Kyoto mechanisms (5.2.2).

5.2.1 Changes in the EU ETS framework

Changes specified in the directive

The overall conditions for the EU ETS in the period 2008–2012 are to a large extent given by the directive, and most of the basic principles will remain the same. However, the directive also details a number of differences relative to the first period.

- The possibility to apply for temporary exclusion of certain installations, that Member States have in the present period, will stop,

- the penalty for emissions in excess of allowances increase from Euro 40 per tonne to Euro 100 per tonne,
- Member States can use credits from Joint Implementation (JI) in addition to those from the Clean Development Mechanism (CDM), and
- with the approval by the Commission, Member States can unilaterally include additional greenhouse gases and/or sectors.
-

In addition to the changes specified in the directive, some adjustments in the trading scheme for the period 2008–2012 could be realized during 2006. Thus, based on an ongoing review of the first period, the European Commission will in mid-2006 present a proposal for changes in the EU ETS for the period 2008–2012. At present, it can be anticipated that the negotiations only will lead to relatively minor changes, e.g. the trading scheme will most likely not be amended to include more greenhouse gases or sectors. There is, however, one exception to this, namely the possible inclusion of aviation. The European Environmental Council recently urged the Commission to bring forward a legislative proposal by the end of 2006 on the inclusion of the aviation sector in the EU ETS. However, it is anticipated that the inclusion of the aviation sector would not have any significant effects on the allowance price within Phase II.[28]

For the Nordic countries, the foreseeable changes to the EU ETS are likely to have relatively modest effects, at least on the aggregate level. For example, none of the Nordic countries did temporarily exempt industries in the current trading period. The exception is Norway, which has to negotiate to keep the partial coverage of its current ETS if it should be linked to the EU ETS.

The European Commission's guidelines

At present, the Member States are preparing – or at least planning the process of doing so – their National Allocation Plans (NAP) for the period 2008–2012. The NAPs shall be published and notified to the European Commission and to the other Member States at the latest by the end of June 2006. In the beginning of 2006 the Commission published a document that offers guidance to the preparation of NAPs for the second phase of the ETS.[29]

In general, the Commission aims for more harmonized and transparent allocation methodologies and regulations. The Commission urges Member States to work towards simpler plans for the second trading period. According to the Commission, simple allocation plans boost the understanding of the instrument among stakeholders and also increase transparency and predictability. Thus, the document presents guidance that should facilitate simpler design of the new national allocation plans and

[28] Wit et al. (2005)
[29] COM (2005)703

indications on the amount of allowances allocated in the second phase, which should be less or equal to the amount allocated in the current period. Furthermore, there should not be a continuation of special provisions for process emissions, and no reliance on Phase I emission levels in the allocation plans (i.e. as base period; early actions are recognized).

5.2.2 EU ETS in relation to the Kyoto mechanisms

The second phase of the EU ETS, 2008–2012, coincides with the first Kyoto commitment period. This means that the trading scheme will operate in a different environment than in the first phase. Thus, as all other so-called Annex I countries, the Member States will have binding emission caps for all their greenhouse gases. This implies that not only will the ETS undergo some "internal changes" (as already described in 5.2.1), but also be affected by the framework specified under the Kyoto Protocol. In view of this, we in this section analyze the relation between the EU ETS and the Kyoto mechanisms.

Relation between the Kyoto mechanisms and the EU ETS

The three mechanisms within the Kyoto Protocol will – directly or indirectly – affect the ETS. The mechanisms are:

(i) International Emissions Trading (IET), which enables Annex I countries to trade part of their emission cap under the Protocol. The physical trade with AAUs (Assigned Amount Units)[30] can begin from 1 January 2008, given that the Parties have been deemed to meet all of the eligibility criteria for trading.

(ii) The Clean Development Mechanism (CDM), which enables Annex I countries to implement project activities to reduce greenhouse gas emissions in non-Annex I countries and receive credits, CERs (Certified Emission Reductions). These credits can be used for compliance with emissions reduction targets under the Kyoto Protocol.

(iii) Joint Implementation (JI) which enables Annex I countries to assist other Annex I countries to implement greenhouse gas emissions reducing activities. The assisting country will receive credits, ERUs (Emission Reduction Units), and the assisted country's emission cap will be reduced by the same amount (thereby leaving the total cap among Annex I countries unchanged).

It is important to note that the EU ETS is not part of the IET, and does not allow AAUs to enter into the trading system. However, the ETS is

[30] The Assigned Amount Unit (AAU) assigned to a Party corresponds to the emission cap under the Kyoto Protocol. This is the main unit traded under the IET. Other Kyoto units can also be traded such as so-called Removal Units (RMU) and reduction units achieved through the CDM.

linked to the CDM and JI through the so-called Linking Directive.[31] The Directive specifies to what extent credits from the CDM and JI can be used by installations to comply with their obligations under the EU ETS. Both the CDM and JI can generate emission reduction credits prior to the 2008–2012 period. Credits from the CDM can be used within the current the EU ETS trading period, while credits from JI can only be used from 2008 and onward. It should be noted that the Linking Directive should have been transposed into Member States' national law by November 14 2005, but not all Member States have yet managed to do so.

The limit of credit import for ETS compliance may not be specified in the linking directive but has to be determined in the allocation plans for the second trading period as a share of the allocated allowances either on total level or on installation level. In the Commission's guidelines document regarding allocation for the second period the Member States are however, recommended to avoid specifying the limit at the installations level.

Options for closing of the Kyoto gap

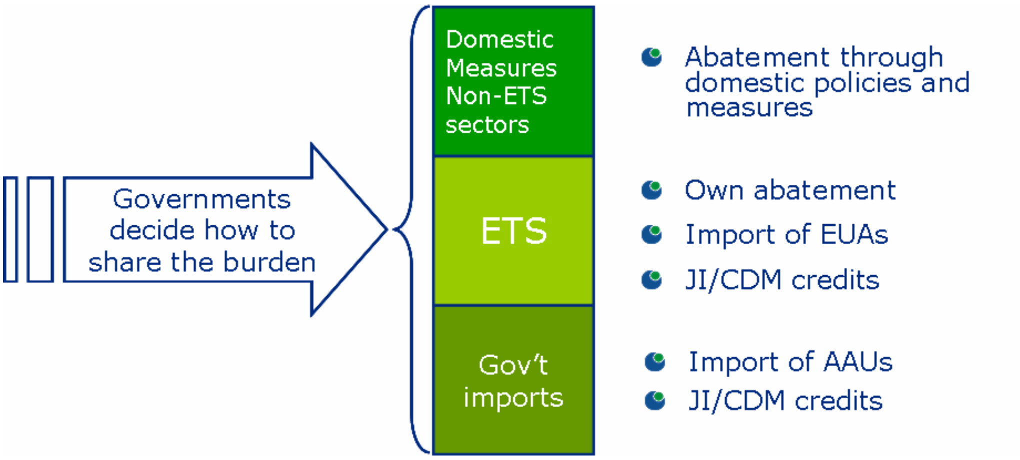
The Kyoto gap, defined as the distance between (projected) emissions in 2008–2012 and the emission cap given by Protocol, can in principle be closed in three ways;

- by using domestic policies and measures to reduce emissions,
- by purchasing EU ETS emission allowances (EUAs), i.e. to allocate less EUAs, or
- by purchasing JI and/or CDM credits and/or AAUs.

It is the Government that has to decide on how to allocate the burden among different options as illustrated in Figure 5.2.

[31] Directive 2004/101/EC.

Figure 5.2 Options for closing the Kyoto gap



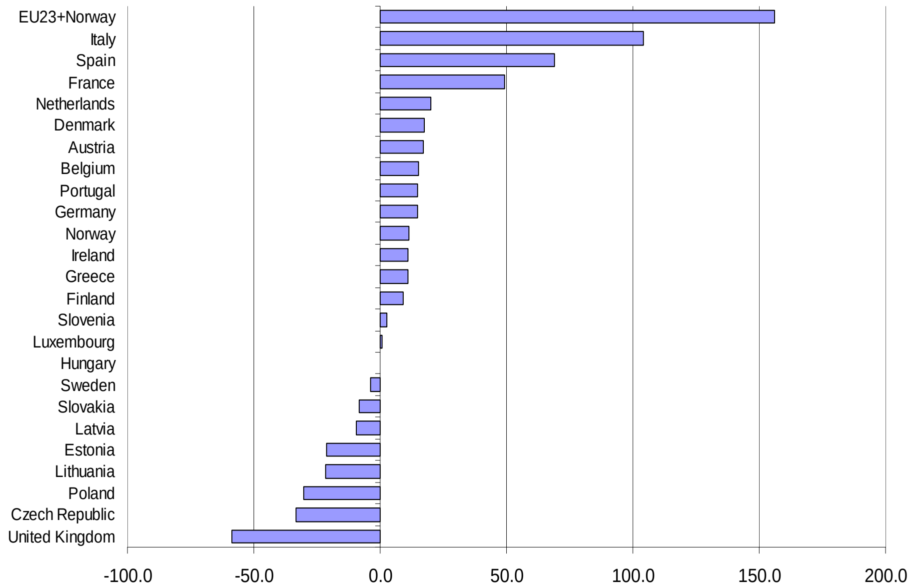
The EU emissions trading system will to some extent help the participating countries to close the gap in a cost efficient way. The contribution of the EU ETS will be known when the final NAPs for Phase II are settled at the end of 2006, whereas the contribution of the impacts of the domestic policies and measures are only likely to be known after the end of the Kyoto period.

The Nordic countries' use of the different Kyoto mechanisms as well as the EU ETS will, at least indirectly, be dependent on other Annex I countries' demand for AAUs, CERs and ERUs, and the EU countries allocations of EUAs. The action taken by other Annex I and EU countries will affect the price of the different "climate commodities" (EUA, CERs, ERUs, and AAUs) and should therefore influence the policy of the Nordic countries. The Kyoto gap in all EU countries and other Annex I countries is a first indicator of the likely net demand for the "climate commodities" and should be watched closely by countries when deciding on their strategy for the 2008–2012 period.

Emission projections of the EU Member States shown in figure 5.3 indicate that the union as a whole will have a positive Kyoto gap corresponding to 144.8 Mt CO_2-equivalents p.a.[32]

[32] European Environment Agency (2005), "Greenhouse gas emissions trends and projections in Europe 2005", EEA Report No 8/2005

Figure 5.3 The Kyoto Gap in EU Member States and Norway (Mt CO_2/year)



Source: EEA (2005), www.ssb.no

The relative size of the gap varies however among Member States, with Denmark, Norway and Finland belonging to the group with a positive gap to close. Several Member States have presented purchase plans for CERs and ERUs to help closing the gaps shown in Figure 5.3. Although these purchase programs will alleviate some burden from both the ETS and other sectors, there is still a substantial part left to be reduced through the ETS and/or domestic policies and measures.

On the supply side there are several Annex I countries with negative Kyoto gaps that will be the main suppliers of AAUs and JI credits. However, the supply of allowances and credits are to a large extent determined by the way Russia and Ukraine and other Economies in Transition will handle the excess of AAUs these countries have. Credits from CDM projects will also increase the supply. The number of registered CDM projects is increasing. It is so far uncertain how many of these credits will be generated and issued before the end of the second trading period.

6. Other instruments and strategies 2008–2012

In the theoretical and quantitative assessments surveyed and discussed in previous chapters of this study, some conclusions were drawn concerning the use of other instruments in combination with ETS. It now also appears as if the EU ETS is working properly and that only minor adjustments to the system will be made in the second trading period. With this as the point of departure, this chapter looks at the Nordic countries current and planned use of climate policy related instruments.

6.1 Current instruments

The Nordic countries have a tradition of relatively tough environmental policy, and for quite a long time they have had explicitly formulated climate change strategies. Both regulatory and economic instruments are used to achieve environmental policy goals. Accordingly, the Nordic countries on general use an array of different instruments with the purpose of reducing GHG emissions, e.g. taxes, regulations, subsidies, long-term voluntary agreements, etc. This is illustrated by table 6.1, which summarizes the major climate related instruments in use in the different Nordic countries today besides emissions trading.

Table 6.1 Climate related instruments used in the Nordic countries

Instrument	Denmark	Finland	Iceland	Norway	Sweden
CO_2 tax	Yes (Reduced rate on energy intensive industry)	Yes (Excludes fuel peat. Partial refund may apply to energy intensive industry)	No	Yes (Sectors exposed to international competition are either exempted or have reduced tax rates)	Yes (Reduced rate on energy intensive industry)
Energy tax	Yes (Refunded tax if used for industrial processes)	Yes (Lower electricity tax rate for industry. Partial refund may apply to energy intensive industry)	Yes (On gasoline only)	Yes	Yes (Industry largely exempted)
Long term, voluntary agreements (LTA)	Yes	Yes	Yes	Yes	Yes
Subsidies	Yes	Yes	No	Yes	Yes
Green certificates	No	No	No	No	Yes (Energy intensive industry exempted)
Regulation concerning BAT and/or GHG emissions	Yes	No (But energy efficiency is a relevant issue included in permit procedures)	No	Yes	Yes (Less strict on trading sectors)
Use of CDM/JI	Yes	Yes	No	Not decided	No (Only pilot projects)

On the surface, table 6.1 may give the impression that the Nordic countries, with the possible exception of Iceland, are more or less homogenous with respect to the use of measures to combat emissions of GHGs. However, as is evident from the following discussion of the various instruments, the application of the different measures differs in many aspects between countries.

CO_2 tax

All Nordic countries except Iceland use a carbon dioxide tax. Generally, the tax is levied on the use of fossil fuels in relation to their carbon contents, but there are differences in how the tax is imposed. Thus, as is shown by the following examples, a number of different exemptions are used:

- In Finland, the energy intensive industries are entitled to an 85 percent tax refund if the cost of the electricity and carbon dioxide tax exceeds 3.7 percent of the concerned industry's value added, for the part exceeding 50 000 Euro.
- In Sweden, industry is levied a reduced tax rate and is entitled to further reduction of the marginal tax rate if the industry's cost of the tax exceeds 0.8 percent of their value added.
- In Norway, sectors exposed to international competition are either totally exempted from the tax, or have reduced tax rates. 85 percent of the GHG emissions from industry are exempted from the CO_2 tax.
- In Denmark, the carbon dioxide tax is levied on fuels used for space heating and, with reduced rates, on process emissions. Contrary to the other Nordic countries, Denmark also uses a carbon dioxide tax on electricity consumption.

Energy taxes

All Nordic countries use energy related taxes, but the tax design differs between countries. The purpose of the energy related taxes are primarily fiscal, although the taxes clearly also have an effect on energy consumption and hence on CO_2 emissions.

Denmark levies a tax on fossil fuels based on the energy content. Gasoline and diesel are taxed at a higher rate, with specific gasoline and diesel taxes. Swedish energy tax on fuel differs between fossil fuel types, but do not depend on energy content. Finland levies energy taxes on fossil fuels used for transport and heating purposes and on electricity. Norway levies taxes on oil products for transport and heating purposes. Iceland levies tax on gasoline but diesel driven cars are instead levied a fix tax based on vehicle weight or a mileage tax. All countries except Iceland tax electricity consumption and therefore exempt fuels used for electricity production from energy taxes.

In all countries, the industry is exempted from energy and electricity taxes, or at least levied substantially reduced tax rates. In Denmark, VAT-registered companies are in practice exempted from the energy tax, since they are refunded most of the tax they pay.[33] Swedish industry is exempted from the energy tax on fuel consumption and is charged a substantially reduced tax rate on electricity consumption. Industrial processes in the Norwegian manufacturing, mining, mineral and parts of the chemistry industry are exempted from electricity tax. In Finland, a lower electricity tax rate applies for industry, compared to other electricity users. In addition, the energy intensive industry is entitled to a partial tax refund as described above.

Agreements

Some sort of voluntary agreements are used in all Nordic countries.
In Denmark, companies in the energy intensive industry can obtain a significantly reduced CO_2 tax rate if they enter into an agreement with the Energy Agency. In exchange for the tax reduction, the agreements require the companies to carry out certain energy saving investments. So far (2004) approximately 100 agreements with energy intensive industries have been entered into, covering close to half of the industries' energy consumption.

In Finland, the industry has been provided with an opportunity to entering into voluntary energy conservation agreements with the government. By the end of 2002, these agreements had generated energy saving measures equalling in total 4.1 TWh.

In Norway, the aluminium industry agreed to reduce GHG emissions per unit aluminium produced by 50 and 55 percent in 2000 and 2005 respectively, compared to the 1990 level. The Federation of Norwegian Process Industries signed an agreement to reduce GHG emissions from the process industry (except refineries and oil/gas processing onshore) by 20 percent in 2007 compared to 1990. The agreement would cover gases and emission sources that are both included and not part of the emissions trading system in 2005–2007. The agreement covers process emissions from 60 plants in the aluminium, ferroalloys, carbide, other metals and fertilizer industries as well as some other industries.

The Icelandic government and aluminium smelters have entered into a voluntary agreement with the goal to reduce PFC emissions per production unit.

Swedish energy intensive industry can be exempted from the electricity tax (i.e. from the minimum electricity tax) if they enter a 5-year programme for greater energy efficiency. The programme was introduced in January 2005.

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[33] It should be noted, however, that they are *not* refunded the tax they pay on the use of fuel for engines and for heating purposes.

Subsidies and green certificate systems

Subsidies to renewable energy production and energy conservation are used in all Nordic countries except Iceland.

Sweden uses investment subsidies through investment programmes with an explicit focus on climate measures. Within these programmes, municipalities and industry can apply for subsidies for investments that have a long-term effect on emissions of GHGs. Furthermore, Swedish renewable electricity production using wind power receives investment support. In addition, wind power produced electricity receives an "environmental bonus", and large-scale wind power receives a subsidy in order to facilitate market introduction. These grants may, however, be phased out due to the introduction in May 2003 of the green (renewable energy) certificate system, a quota-based system which requires electricity consumers to purchase certificates in relation to their electricity consumption. Other investment subsidies, to biomass and small-scale hydropower, were in fact phased out when the green (renewable energy) certificate system was introduced. Electricity intensive industry is exempted from the quota obligation.

Denmark supports environmentally friendly energy production with a price up-lift to decentralised thermal power plants and wind power. For decentralised thermal plants, the support depends on the type of fuel. Plants with renewable fuels receive a support that together with the market price secures a price at a certain level and there is also "guarantee prices" for wind power produced electricity.

Norway has established an Energy Fund to support investment for a long-term development towards alternative energy production and more efficient energy use. The goal is to contribute 12 TWh per year of energy savings and production of new, renewable energy within 2010.

Finland uses subsidies for promoting renewable energy sources and energy conservation. An investment subsidy is available for energy production investments using biomass, wind power and other renewables as well as for investments in energy conservation. In addition, electricity produced from renewable energy sources and recycled fuels receive a kWh-based production subsidy, which is differentiated between energy sources.

Regulation concerning Best Available Technology (BAT) and/or GHG emissions

The Swedish Environmental Code includes a number of principles that apply to commercial activity and that have an effect on the emissions of greenhouse gases. There is a requirement for plants to use the best possible technology and to use renewable resources in the first hand and also requirements concerning the emissions of CO_2 and the quantity of fossil fuel that can be used.

The Norwegian Pollution Act mainly covers pollution from stationary sources. According to current practice, regulation of plants applying for permission for activities resulting in harmful emissions (also CO_2 emissions of any significance) is carried out in the emission permits. In some cases limits for total CO_2 emissions have been set. So far these limits have been set according to the need of the plant, and have thus not constituted any limits on CO_2 emissions. However, through limits on the production level, energy efficiency requirements etc. the permits indirectly impose some limitations on CO_2 emissions.

The Finnish implementation of the IPPC directive excludes regulation of GHG emissions, which instead are managed separately (by the other instruments described in this study) from the permitting procedure. Although GHG emissions are reported in environmental permit applications and monitoring reports, environmental permits do not include e.g. limits or target values on GHG emissions. However, the permit may include provisions related to energy efficiency, where BAT-reference documents are used as guidelines

As an EU Member State, Denmark has implemented the IPPC directive, and there are BAT-requirements in play.

The use of JI and CDM

Although not actually a part of "current instruments", JI and CDM related activities are already taken place or being planned for in the Nordic countries, both by implementing the Linking Directive and by setting up governmental JI/CDM purchase programmes. As was noted in chapter 5, credits from the CDM can be used within the EU ETS already in the period 2005–2007. The Norwegian emissions trading law opens for the use of CDM in the Norwegian emissions trading system in the period 2005–2007, based on the same rules as in the EU ETS trading system. As of February 2006, of the Nordic Member States only Denmark has transposed the Linking Directive into national law, but Finland and Sweden is in the process of doing so. Danish participants in the EU ETS can hence use credits from approved CDM projects within the EU ETS.

According to EEA (2005), only three the EU15 countries, Germany Sweden and United Kingdom, have announced that they do not intend to use credits from Joint Implementation (JI) and the Clean Development Mechanism (CDM) in order to fulfil their commitments in the period 2008–2012. In the Nordic countries both Finland and Denmark has allocated resources for governmental purchase programs.

The Danish governmental programme to purchase credits through the use of JI is already operating, and includes co-operation with several countries. Finland plans to purchase a significant amount of credits to be used in the period 2008–2012. Sweden, on the other hand, have programmes for JI and CDM, but have not yet decided in what way the credits will be used. There are currently no Norwegian public programmes etc. for the acquiring of JI and CDM.

6.2 Changes due to emissions trading

The introduction of the EU ETS has so far led to some changes in other climate related measures.

In Sweden, some changes have been made in the environmental legislation. Thus, the requirements in the Environmental Code concerning restrictions on emissions of carbon dioxide and on the quantity of fossil fuel used have been removed for plants covered by the EU ETS. There is, however, still a requirement in the Environmental Code that plants should use the best possible technology and use renewable resources in the first hand.

The Swedish sectors under the EU ETS are levied a reduced CO_2 tax rate. The governmental FlexMex2 Commission suggested that the carbon dioxide tax for the sectors covered by the trading system should be abolished.[34] The budget bill for 2006 proposed that the carbon dioxide tax on the emissions trading sector should be removed for the industry and (parts of) the combined heat and power, and reduced for other installations within the energy sector.[35] This change was proposed to be effectuated in January 2006.

Finland has introduced a CO_2 tax relief on heat production with peat and removal of electricity generation subsidies for electricity generation with peat. The main reason for these changes was to compensate for the loss of competitiveness against other fuels caused by the introduction of the EU ETS. A second reason was to reduce the risk of increased costs of raw wood to chipboard and fibreboard industries. In order to safeguard international competitiveness of the Finnish industry within the EU ETS, the electricity tax levied on this industry will be lowered.

Norway limits the trading system to those emissions that are not covered by the CO_2 tax system, since no changes in the latter system is wanted. There are, however, emissions from several industries (i.e. process emissions from aluminium etc.) that neither are covered by the EU emissions trading directive, nor by the Norwegian CO_2 tax. The Norwegian government therefore decided that some policy instruments should be directed towards these emissions as well. This is the reason why a new agreement on emissions reductions was signed between these industries and the authorities, as described above.

[34] The Commission did however suggest that the tax should be maintained on district heating which at the margin should pay the tax plus the emission permit price. The double burden for the heat producers was suggested to assure that the introduction of emissions trading did not result in a decrease in the use of biofuels in this sector.

[35] Prop. 2005/06:1

Due to the implementation of the emissions trading system, Norway has also made some changes in the Pollution Act, albeit of a merely technical nature, in order to ensure that the law's status towards the GHG emissions remains unchanged.

In Denmark, a national emissions trading system has for some years been in operation, in order to curb carbon dioxide emissions from electricity production. Due to the obvious overlapping of the national emissions trading system and the EU ETS, the national system was abolished in 2005.

In connection with the start up of the EU ETS, a decision was made to refund the CO_2 tax paid for fuel and heating used in industrial processes that are allowance regulated in sectors covered by the ETS. However, this change is pending approval by the European Commission and has therefore not entered into force.[36]

6.3 The balance between emissions trading and other instruments

In all concerned Nordic countries, the EU ETS was largely implemented alongside existing policy instruments such as carbon taxes, energy taxes and green certificates.

As discussed in the previous chapters, this could potentially lead to many complex instrument interaction problems, concerning relations both between the trading and the non-trading sectors and between different parts of the trading sector. That is, due to the partial sectoral coverage of the EU ETS there could be a problem of "balancing" emissions trading with the use of instruments in the non-trading sector to achieve emission reductions in line with the path towards reaching the Kyoto commitment. Although it is not easy to decide what an optimal path to the emission target is, it is true that if a country distributes more emission allowances, this will automatically create a need for an increased use of measures to curb emissions in the non-trading sector.[37] The chosen balance will most likely have implications for the aggregate cost of reaching the emission target.

The Nordic countries will face the above-mentioned balancing problem between the trading and the non-trading sectors in different ways, given that the trading sector's share of emissions varies quite a lot between the countries. This was illustrated in table 5.1 (see section 5.1.1), which shows that, for instance, the Finnish trading sector stands for approximately 71 percent of the country's total CO_2 emissions, whereas the

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[36] Danish Ministry of the Environment and the Environmental Protection Agency (2005b)

[37] This is, however, not entirely true for Sweden due to the Swedish emission target which only concerns emissions within the country and hence is unaffected by the allocated amount of emission allowances. That is, increased allocation of allowances does not directly imply that a higher burden will be given to the non-trading sector.

Swedish trading sector only stands for approximately 42 percent of Sweden's total CO_2 emissions.

Another issue is the balance between instruments used within the trading sector. In a textbook ETS, the marginal abatement cost is equalized among polluters, which guarantees that abatement is carried out where the cost is lowest. By using "extra" instruments on these sectors there is a risk that the marginal abatement cost will differ among countries and/or polluters within the EU ETS, thereby affecting the overall effectiveness of the system.

Table 6.2 presents an overview of the use of emissions trading, i.e. the allocation of allowances relative emission levels, and the use of other instruments in the trading and non-trading sector.

Table 6.2 Overview of the current use of emissions trading and other major instruments

Source: Tax rates from the European Commission (2006), Norwegian Ministry of Finance and Swedish Energy Agency (2005).

	Denmark	**Finland**	**Norway**	**Sweden**
ETS **Relative allocation** **2005–2007**	Power and heat production: 96 % of 2002 emissions Others: 110 % of 2002 emissions	Power and heat production: 105 % of average emissions 1998–2002 / 2000–2003 Others: 119 % of average emissions 1998–2002	Power and heat production: 95 % of average emissions 1998–2001 Others: 95 % of average emissions 1998–2001	Power and heat production: 80 % of average emissions 1998–2001 Others: 100 % of average emissions 1998–2001. 100 % of projected process emissions.
Other measures on trading sector1	Tax on electricity: Approx. 0 due to reimbursement (but 89.2 if used for heating) Tax on fossil fuels: Industry pays the general tax rate on fuels used for heating and gets a 72 percent reduction on the CO_2 tax on emissions from heavy processes. VAT registered companies are in practice exempted from energy tax. LTA: Further reductions of CO_2 tax on processes with agreements Subsidies: Support to renewable energy production.	Tax on electricity: 4.4 (The tax rate will be reduced by 50 %) Tax on fossil fuels: Energy intensive companies get an 85 % refund if CO_2- and electricity tax exceeds 3.7 % of value added. LTA: Energy conservation agreements Subsidies: Some investment subsidies available concerning new technology (renewable and energy conservation).	Tax on electricity: 0.59 Tax on fossil fuels: : Industry pays the general tax rate on oil used for heating LTA: Emission reduction agreements Subsidies: Investment support, innovation subsidies	Tax on electricity: EU minimum tax. Tax on fossil fuels: Industry pays less than 20 % of the full general tax rates on (non-transport) fossil fuel. Further reductions available for energy intensive industry. LTA: Limited use. Reduced electricity tax rate with LTA Subsidies: Some investment subsidies available (to decrease GHG emissions)
Measures used in non-trading sector1	Tax on fossil fuel: Natural gas: 6.93, 9.41 (industrial use) Coal: 8.24 Heavy Fuel Oil: 319.9 Unleaded Petrol: 0.51 Gas Oil: 0.40 Tax on electricity: 80.5 (89.2 on business use but substantial reimbursement of duty paid available for most VAT registered companies.)	Tax on fossil fuel: Natural gas: 0.53 Coal: 1.75 Heavy Fuel Oil: 59.6 Unleaded Petrol: 0.59 Gas Oil: 0.34 (propellant), 0.07 (industrial use and heating) Tax on electricity: 7.4, 4.4 (business use) Subsidies: Energy related investment subsidies available concerning new and traditional technology.	Tax on fossil fuel:2 Natural gas: 0 Coal: 0 Heavy fuel Oil: 120.7 Unleaded Petrol: 0.61 Gas Oil: 0.44 (propellant), 0.13 (industrial use and heating) Tax on electricity: 13.1, 0.59 (industry)	Tax on fossil fuel:3 Natural gas: 5.92, 3.00 (propellant) Coal: 9.82 Heavy fuel Oil: 380.2 Unleaded Petrol: 0.54 Gas Oil: 0.39 (propellant), 0.36 (industrial use and heating) Tax on electricity: 28.0, 21,6 (northern Sweden) Green certificates: Approx. 2.9 Subsidies: Some investment subsidies available (to decrease GHG emissions)

Note: [1)] Total marginal tax rates excl VAT. Natural gas and coal in Euro/gigajoule; heavy fuel oil in Euro/tonne; petrol and gas oil in Euro/liter; electricity and green certificates in Euro/MWh. Green certificate price in 2004. (Exchange rate used: SEK 9.3086, DKK 7.4628 and NOK 8.0092 per Euro). [2)] Natural gas and oil used in petroleum activity on the continental shelf are taxed at a higher rate. [3)] Lower tax rates applies for some use in agriculture and horticulture.

The allocation of allowances to the trading sectors gives a first indication of the relative burden between trading and non-trading sectors in the economies. As is shown in table 6.2, all countries except Norway allocate more than the base year's emissions to the sectors outside power and heat production. The allocation to the power and heat production is for all countries except Finland less than the base years' emissions. The total allocation of allowances seems, however, in all countries to be lower than total projected "need" in the period 2005–2007. From this point of view, the trading sector has not been "over allocated" allowances.

Given that there are no national emissions targets for the period 2005–2007 it is, at this stage, difficult to state that the allocation of allowances directly increased the burden on the non-trading sector. However, that the allocation is less than the "need" indicates that all countries use the ETS to alleviate some of the burden on the non-trading part of the economy.

The main emitter of CO_2 outside the trading sector is the transport sector. Transport is also a source of CO_2 emissions with large projected emissions to 2010 in all Nordic countries participating in the EU ETS. The balance between measures in the trading sector and the non-trading sector therefore to a relatively large extent concerns the balance between measures on transport and on trading sectors.

In general, all countries tax gasoline and diesel used for transport at a higher rate than fossil fuels used in the trading sectors. As is shown in table 6.2, the trading sector, especially energy-intensive industry, is levied a substantially reduced fossil fuel tax rate. Hence, the marginal cost of increased emissions is lower in the trading sectors, if the cost of emission allowances is disregarded.[38] Since only relatively small changes of climate related measures have been made due to the introduction of EU ETS, the balance between the trading and the non-trading sector has so far not changed in favour of the trading sector if the marginal cost of emissions is compared. That is, regardless of the amount of emission allowances allocated to the trading sectors, the EU ETS has increased the (opportunity) cost of emitting CO_2 on the margin in the trading sectors.

Although the CO_2 tax raises revenue, the main purpose of the tax in all countries is the same as the rationale for the implementation of the ETS, namely to cost effectively reduce CO_2 emissions by increasing the marginal cost of such emissions. The introduction of EU ETS added an extra cost on the margin to the trading sector. The CO_2 tax could, as discussed in chapter 3, potentially affect the trading system's effectiveness negatively as it disturbs the ETS's prospect to equalize marginal abatement costs, which is the fundamental property of emissions trading. Recognizing this, Norway limited the ETS to cover the emissions that were not already covered by the CO_2 tax. Sweden and Denmark has recently proposed abolishment and/or reduction of the CO_2 tax on the sectors covered by the ETS.

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[38] The effect on the marginal cost of other measures such as LTA is however difficult to assess.

Within the EU there is a wish to increase the share of renewable energy in the energy balance. The aim is to reduce CO_2 emissions and improve the security of energy supply by reducing the EU's growing dependence on imported energy sources. Sweden uses a system of green certificates as a measure to increase the share of renewables. In addition to the Swedish system, the Nordic countries use different kinds of subsidies to renewable energy production. Clearly, the need for green certificates and the subsidies are at least partly offset by the ETS. That is, the ETS reduces the relative cost of power production with renewable sources and consequently will reduce the need to use other instruments to achieve the target concerning the use of renewables. The green certificate system will, for a given quota of certificates, to some extent "automatically" adapt to the ETS through lower certificate prices. The investment and/or the price subsidies on renewable energy, on the other hand, might "over compensate" the use of renewable energy production as this type of production will benefit from the introduction of the ETS. No major change to the subsidies has, however, been made with explicit reference to the ETS.

Finally, it should be noted that it is not straightforward to compare marginal levies on fossil fuel consumption between the trading and non-trading sector within a specific country due to uncertainties concerning the marginal cost effects of different instruments, e.g. subsidies and long term agreements. These uncertainties clearly makes assessments of the climate policies cost efficiency difficult and complicates the shaping of national climate policy to achieve the correct balance between the use of ETS and the use of other measures.

6.4 The Nordic countries' climate strategies in 2008–2012

As was mentioned earlier, the Nordic countries have for quite a long time had explicitly formulated climate change strategies. In this section, we present an analysis, country by country, of the strategies and how they have been affected by the introduction of emissions trading.

On general, it should be noted that the climate strategies have been under revision in many of the Nordic countries during the last couple of years or so. Thus, Finland (late 2005) and Sweden (March 2006) have recently presented new, or at least revised, climate strategies, while Iceland will probably do so later this year. One of the circumstances that have brought about the need for revision is most likely the introduction of emissions trading.

However, with the notable exception of Finland, the climate strategies currently in force are still "older" ones. Thus, the Danish strategy was approved in 2003, the Swedish in 2002, and the Norwegian in 2001. In view of this, it may be a bit premature to try to give a definitive answer to the main question for this study, i.e. in what way will the countries' climate strategies be affected by the introduction of emissions trading.

Nevertheless, the countries will have to take some important decisions concerning the use of emissions trading and other instruments before the end of 2006 due to the EU ETS process. Some indications concerning the plans of using of different instruments to fulfil Kyoto commitments has been given by the different governments, for instance in Government Bills in connection to the proposals of National Allocation Plans and in the countries 4th National Communication on Climate Change under the UNFCCC.

The rest of this subsection will, given current knowledge, discuss the different plans for the Nordic countries for the period 2008–2012 roughly based on the three options available as described in section 5.2.2. Table 6.3 at the end of the chapter provides an overview of the plans.

Denmark

The Danish climate strategy, which was approved in March 2003, points out that Denmark's commitments under the Kyoto Protocol and the EU's Burden Sharing Agreement should be attained in a cost efficient matter.[39] In general, the Danish approach is focused on cost efficiency and, due to e.g. continuously changing economic framework and technological development, flexibility regarding choice of measures. The government has, for example, decided to appoint a standing climate committee that should work continuously to ensure cost effective implementation of climate policy.

According to the Climate Strategy, efforts from central authorities could supplement efforts by the private sector. The point of departure is that reduction efforts are primarily tasks for private sector, not least the sectors participating in the EU ETS, The authorities could however contribute by getting the market for the CO_2 credits started in the initial phase. The central authorities are hence concentrated on JI and CDM projects.

The governmental Climate Committee continuously monitors the Danish Kyoto gap and assesses effects of climate measures to ensure proper coordination and prioritisation between different measures, i.e. domestic measures, the use of EU ETS, and the use of the flexible mechanisms. As described in chapter 2, the latest "with existing measures" projections of emissions in Denmark indicate that the Kyoto gap will correspond to approximately 17.3 Mt CO_2 equivalents annually.[40]

[39] Danish Ministry of the Environment and the Danish Environmental Protection Agency (2005b).

[40] This gap might be reduced by 5.3 Mt, i.e. to 12.3 Mt, if the Danish base year emissions are adjusted for electricity imports in 19990, an issue currently being discussed but not yet decided on. See chapter 2.

Although the government's view is that purchase of JI and CDM credits are primarily a task for private businesses participating in EU ETS, public funds has been allocated to JI and CDM projects. DKK 1.13 billion has been allocated for purchase of CERs and ERUs in the period 2003–2008. With an assumed price of DKK 50 per ton CO_2, these funds will reduce the Danish Kyoto gap by 4.5 Mt per year in 2008–2012. This leaves a reduction need of 12.8 Mt annually to be divided by the sectors participating in EU ETS and the non-trading sectors.

As all other countries that have ratified the Kyoto Protocol, Denmark also need to fulfil its commitments using the flexible mechanisms as a supplement to domestic measures as specified in the Marrakech accordance. What supplementary represent in terms share of total emissions is however still not fully clear. It is quite possible that a relatively large room for using the mechanisms are allowed, especially for countries that, as the Nordic countries, have already applied several different domestic measures since the base year 1990.

According to the Danish climate strategy, a relatively large burden of the closing of the remaining Kyoto gap will be assigned to the businesses covered by the EU ETS. In addition, the Danish implementation of the Linking directive did not put any restrictions on the trading sectors use of JI and CDM credits.[41] The current strategy does, however, not explicitly assign a certain amount of allowances and therefore the exact burden allocated to the trading sectors will most likely not be known until the allocation plan is handed in later this year. Needless to say, nothing is settled until the Commission has approved the plan.[42]

Currently the best guidance on this issue is the recommendation provided by the Commission in the guidelines on allocation plans for the period 2008–2012. In those guidelines, Denmark belongs to the group of Member States that are pointed out to be "not sufficiently on track towards meeting their Kyoto targets". The guidelines also indicate that the Member States with a positive Kyoto gap should as an aggregate at least reduce their allocated amount by some 6 percent compared by the allocation in 2005–2007, unless strong efforts by the non-trading sector are carried out.

If Denmark would to reduce its allocation by 6 percent the allocated amount will correspond to 31.5 Mt CO_2 equivalents per year. This, in turn, would leave approximately 19 Mt CO_2 equivalents annually for the non-trading sector to emit.

Regarding domestic measures, the Danish "with existing measures" projection show that transport, agriculture/forestry and the domestic sec-

[41] There is still a possibility that such restrictions could be imposed when the National Allocation Plan is handed in later this year.

[42] Some indications on the new allocation plan are given in Denmark's 4th National Communication on Climate Change (Danish Ministry of the Environment and the Environmental Protection Agency, 2005a) where it is stated that "it is expected that this plan will include significant tightening of the number of allowances to ensure that Denmark meets its international climate commitment".

tor, i.e. the major non-trading emitters, together will emit 30.8 Mt CO_2 equivalents annually in the Kyoto period. To achieve a reduction of these emissions toward 19 Mt per year is likely to involve relatively tough policy and measures in the non-trading sector.

In order to assess the possibilities of implementing additional domestic measures the government has set up an interdepartmental project, "the Policies and Measures Project". The project is expected end in 2006 and the results are to be used as a basis for the allocation plan 2008–2012. Among other things, the project investigates the possibilities in the transport sector. The government will also appoint a committee to investigate the options for reorganising the total motor vehicle tax system in a revenue neutral way that promotes the environment. However, in the progress report on Denmark's climate policy objectives and achievements[43] it is concluded that, in most cases, new measures in the transport sector demand a common effort within the EU to become sufficiently effective. In the report, it is also noted that certain possibilities exist for emissions reduction in the agriculture and forestry sector. The economic instruments in these sectors are subsidies of planting of windbreaks and forestation with a relatively small estimated effect. The new measures in the domestic sector are, beside the ETS which applies to electricity production and district heating, of informative type with focus on energy saving, e.g. energy labelling of buildings.

The Danish overall tax freeze in effect since 2002 imply that no tax rate may be increased. This also applies to CO_2 and energy related taxes. Nevertheless, the government wishes to modernize and simplify the energy and CO_2 tax system, taking into account the effects from the EU ETS, and will therefore present a proposal on the subject where considerations are taken to the introduction of EU ETS.

The Denmark's 4th National Communication on Climate Change[44] describes some new measures which could have effect on greenhouse gases and which are being implemented within the energy sector. These include price supplement to environmental friendly electricity, tenders for offshore wind turbines, scrapping scheme for old wind turbines, a biomass agreement, and energy research. The objectives of these instruments are, beside CO_2 reductions, to promote energy efficiency and research and development within the energy sector.

Finland

The Finnish government presented a new national energy and climate strategy to the parliament in the end of November 2005.[45] The strategy describes measures needed to meet Finland's commitments under the Kyoto Protocol. The Finnish decisions on emission reduction are based

[43] Danish Ministry of the Environment and the Environmental Protection Agency (2005b)
[44] Danish Ministry of the Environment and the Environmental Protection Agency (2005a)
[45] Government of Finland (2005)

on the fact that the costs for greenhouse gas mitigation in Finland are the third highest in EU area.

In the coming years, it is expected that the growth of the emissions will slow down. The key drivers for emission development, according to the scenarios, are the economic growth and its structure as well as the forms of energy production – especially supply solutions of electricity. It is expected that the commissioning of fifth nuclear power plant will reduce the emissions to some extent leaving approximately 15 percent higher emissions than agreed in Kyoto agreement for the years 2008–2012, corresponding to a Kyoto gap of 11 Mt per year.[46]

To reduce the presumed high burden of emission reductions on the economy, the Finnish government plan to utilize the flexible mechanisms of the Kyoto Protocol. The government is prepared to cover the expenses of JI and CDM credits totalling 10 Mt during the years 2008–2012, i.e. 2 Mt per year. In addition, the CDM/JI pilot programme launched in 1999 is estimated to yield approximately 0.4 Mt per year. This leaves a reduction need of 8.6 Mt per year to be divided between EU ETS and non-trading sectors. The Finnish government estimates that the emission reduction achieved in the non-trading sector will be about 1 Mt CO_2 equivalents per year.

The preparation of EU ETS allocation plan of emission allowances for years 2008–2012 has started and it has been suggested that same types of subcategories will be used as during the current trading period. Some significant changes have been proposed such as the power plant's efficiency will be taken into account when determining the emissions allowances for power plants. The climate strategy suggests that subsidies to trading sectors in other areas than new technology and pilot projects should be abandoned. In the "with existing measures" projections Finland estimate a use of EU ETS corresponding to a reduction of 5.9 Mt CO_2 equivalents per year.

Regarding the use of domestic policies measures energy conservation is considered important, and the basis on conservation is built up on EU directives. In Finland, the conservation is based on voluntary actions such as energy conservation agreements, energy audits and other energy conservation programmes. Energy conservation is seen as especially important for the non-trading sector. It is also recommended to advance fast with energy conservation preparations and to pay attention on new energy efficient technology and commissioning of innovations in this area. The strategy also states that energy conservation actions have been successful so far and the target is to continue and even intensify this development. With new conservation actions including actions determined in EU directives, it is targeted additional 5 percent savings by the year 2015 compared to development without new actions.[47]

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[46] Finnish Ministry of the Environment (2006)
[47] Ibid

In the non-trading sector, the strategy aims to increase the use of renewable fuels, especially forest residue, energy crops, biogas and small-scale use of wood. The target is to increase the use of these sources by 65 percent from 2003 figures by the year 2015. Especially the use of renewable energy sources is considered vital in small regional heating plants or in buildings having own heating centres that are not part of the trading sector.

Agricultural policy has a central role in supporting production of bio energy. The use of energy crops will be advanced also with supporting the development of adequate technology.

In the transport sector, attention will be paid to the public transportation, how to take CO_2 emissions into account in vehicle tax (working group established) and how bio fuels should be utilised (working group established). In Finland's "with existing measures" projections it is estimated that the measures in the transport sector will reduce emissions by 0.5 Mt CO_2 equivalents per year.

Small-scale use of wood in energy production will be promoted in various ways. These include supporting the technology development, providing information and using other economic instruments.

The potential to increase hydropower production is limited without changes in prevailing laws. When renewing the water legislation, the possibilities to increase hydropower production will be examined. There is a lot of potential in increasing wind power in fjeld areas and coastline, especially at sea. Although the strategy states that cost-effectiveness of wind power is rather low in GHG reduction, the strategy considers that the wind power should be promoted in Finland. This is to encourage development of Finnish technology and improve the export possibilities. However, investment subsidies will only be granted for project utilizing new technologies.

Norway

Norway has supported cost effective emission reductions across different gases, sources, sinks and between nations and sectors. Several Norwegian climate change policy documents have emphasised cost efficiency.[48] By using a uniform policy instrument, either a tax or emissions trading, on most emissions of greenhouse gases, the Norwegian emissions obligations according to the Kyoto protocol should be fulfilled in a cost efficient way according to the policy documents. Use of the protocol's flexible mechanisms has been part of this overall policy, but according to these documents only as a supplement to domestic actions.

According to the "with existing measures projections" Norway has a Kyoto gap to close that corresponds to almost 11 Mt per year in 2008–2012. Calculations made before Norway ratified the Kyoto protocol

[48] See e.g. St. meld. nr. 29 (1997-98), St. meld. nr. 54 (2000-2001), St. meld. nr. 15 (2001-2002) and St. meld. nr. 21 (2004-2005).

showed that it would cost about three times as much to close the Kyoto gap with domestic actions only, compared to the use of flexible mechanisms.[49] However, no detailed guidelines about how the closure should be achieved have been issued so far. A Commission on low emissions was established in 2005 and will deliver a report in 2006 describing how Norway can cut emissions by 50–80 percent by 2050. The government will, partly based on this report, consider long-term emission reduction targets.[50]

Given that there is relatively little information on how Norway intend to close its Kyoto gap, the division of burdens between the governmental purchase of the JI and CDM credits, emission reductions through the ETS, and mitigation using domestic measures is still unclear.

Consecutive White papers on Norwegian climate policy have stated that "a substantial part of the commitment shall be achieved by reductions domestically". It is, however, not obvious what this means for the division of burdens among emissions trading, the non-trading sector and governmental purchase programs. Analyses indicate that without the current climate policy measures the emissions in 2010 would be at least 17–22 percentage points higher in 2010 than the "with existing measures" projections.[51] This could be interpreted that a substantial part of the commitment already has been achieved through reductions in Norway, which would leave large room for use of the flexible mechanisms. However, in its latest budget bill[52] the new government has confirmed that a substantial part of the emissions will be reduced by domestic actions and in addition states that it will present a suggestion on sector specific contributions to Norway's fulfilment of the Kyoto commitment.

The industry could acquire Kyoto units through the emissions trading system. The law on emissions trading in Norway allows for the use of certified emissions reductions from the CDM in the domestic emissions trading system for 2005–2007, but there is still no regulation regarding the use of credits from JI and the CDM in the period 2008–2012. This regulation (and also the scope of the system and the allocation of allowances) is partly dependent on how the Norwegian ETS will be linked to the EU ETS.[53]

It is interesting to note that the emissions trading law opens the possibilities of issuing allowances from investments in abatement projects in domestic sectors outside the present emissions trading regime, and underlines that this should be part of the negotiations with the EU since the ETS does not allow for this today. In other aspects, concerning CDM credits from hydro and nuclear power projects, the law is in accordance with the EU regulations.

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[49] Ot. prp. nr. 13 (2004-2005).
[50] Norwegian Ministry of the Environment (2006)
[51] Ibid
[52] St.prp. nr. 1, Tillegg nr. 1 (2005-2006)
[53] Norwegian Ministry of the Environment (2006)

Regarding the governmental purchase programs, some information is provided in the Norway's 4th National Communication on Climate Change where it is stated that "in the absence of other policies and measures than the trading scheme designed to bring Kyoto units into the Norwegian registry, it is foreseen that the state will acquire the remaining Kyoto units necessary to comply with the quantitative commitments under Article 3.1."

Given that the share of Norwegian emissions that are covered by the ETS is relatively small, the use of domestic measures may become more important in fulfilling the Kyoto commitments. Among the sectors outside the ETS, the petroleum sector, mainly offshore installations, is the biggest emitter. In this sector, the CO_2 tax has been the most important instrument to reduce emissions and has so far had a significant effect. It is however likely that the instrument will not have such a significant effect in the future and other instruments may be required.[54] One of the options for mitigating the emissions that the government is looking into is so-called carbon capture and storage. The new government has declared that it will reinforce various policy measures and public financing in order to advance the realisation of relevant infrastructure and facilities for CO_2 capture and storage. New concessions to gas power plants ought to be based on CO_2 capture and storage. The government has proposed to allocate NOK 20 million to evaluation projects in 2006.

In the transport sector, the second largest emitter among the non-trading sectors, the CO_2 tax is the main instrument to limit emissions. In the budget bill for 2006, the government has proposed to increase the tax rate on domestic aviation, domestic shipping of goods and supply ship, so that these emitters will pay the full CO_2 tax rate that is levied on mineral oil. Other new measures on the transport sector include funds for research on alternative fuels, policies and measures with the aim to stimulate public transport, the use of bicycles and pedestrian transport.

The industry sector emissions outside the emissions trading system will be subject to emission reduction agreements between the government and the industry, and special arrangement with the process industry (including some installations covered by the ETS).

All measures adopted between 1990 and 2004, i.e. excluding emissions trading, are estimated to yield emission reductions somewhere between 8.5 and 11.1 Mt CO_2 per year in the period 2008–2012 (compared with the "without existing measures" projection). New policies and measures (post 2004), excluding emissions trading, would reduce the Kyoto gap further with almost 0.8 Mt per year.[55] This implies that the Norwegian Kyoto gap, excluding the use of emissions trading, JI and CDM credits, would be slightly above 10 Mt per year.

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[54] Ibid

[55] Ibid

Sweden

As described in chapter 2, the EU burden sharing agreement restrict Sweden's emissions of greenhouse gases to 104 percent compared to the 1990 level in the period 2008–2012. However, Sweden also has a national target. Thus, according the current climate strategy that was adopted by the parliament in 2002[56], Swedish emissions of greenhouse gases for the period 2008–2012 are to be at least four percent lower than emissions in 1990. The target should be attained without compensation for absorption in carbon sinks or by flexible mechanisms. If the emission trend proves to be less favourable than anticipated or the measures undertaken do not have the expected effect, the Government can propose additional measures and/or a reconsideration of the target. In this connection, the consequences for Swedish industry and its competitiveness shall be taken into account. In the parliament decision in 2002, checkpoints were set to be carried out in 2004 and 2008. In its proposal for a revised climate strategy, which was presented in mid March 2006, the Swedish government has stated that the target for 2008–2012 shall remain as was decided in 2002.[57] Complementing this, a more long-time target is also introduced. Thus, the government proposes that the emissions for Sweden in 2020 should be 25 percent lower than in 1990. Through a set of checkpoints every five years, starting 2008, the development will be continuously reviewed.

Although the emission target in the Swedish strategy does not take into account emission reductions achieved by using the flexible mechanisms, it does specify that the Kyoto commitment and the national target should be attained in a cost efficient manner. Furthermore, it specifies that the flexible mechanisms complement the domestic measures and will help attaining cost efficiency.

According to the latest "with existing measures" projection, Sweden's greenhouse gas emissions in 2008–2012 will be 1 percent below the 1990 level, i.e. clearly below the commitment according to EU's burden sharing agreement, but above the national emission target. The projection includes the EU ETS with an assumed allowance price of 10 Euro.

Even though Sweden would not need any new measures according to the latest projections, the government is providing funds for JI and CDM projects. The total sum invested is expected to generate credits corresponding to around 5 Mt CO_2 equivalents in the period 2008–2012, i.e. 1 Mt CO_2 equivalents per year. One of the motives behind the projects is to "improve the prospects for Swedish companies of being able to utilize the opportunities behind the Linking Directive in the EU trading scheme".[58]

In mid March 2006, the Swedish government presented its principal view of how Sweden is going to use the EU ETS in the period 2008–

[56] Prop. 2001/02:55, bet. 2001/02:MJU10, rskr. 2001/02:163.
[57] Prop. 2005/06:172.
[58] The Swedish Environmental Protection Agency and the Swedish Energy Agency (2004)

2012.[59] In the concerned government bill it is stated that the national emission target will be taken into consideration in the process of allocating allowances for the period 2008–2012. Furthermore, it is stated that the number of allocated allowances should be lower than the trading sector's expected emissions during the period, and – as far as applicable – also not higher than in 2005–2007. Regarding the allocation to different sectors, it is stated that the competitiveness of industry will be protected, whereas the allocation to the energy sector will be more restrictive.

Since the concerned government bill primarily presents principals, it does not state any explicit figures of the size of the allocation – such figures will be presented later this spring. In our view, however, it can be estimated that, under the current national emission target, the amount of allocated allowances probably will not affect the trading sector in any dramatic fashion. The reason for this is that the trading sector's emissions presumably will, to a large extent, be determined by the price of allowances and the use of domestic measures on this sector. The burden placed on the trading vs. the non-trading sector, as regards the fulfilment of the national target, is therefore difficult to foresee.

Judging by the aforementioned government bill, Sweden's implementation of the EU ETS will not undergo any major changes in 2008–2012. All allowances will still be allocated free of charge. Thus, Sweden will not use the option available in the directive of allocating up to 10 percent of the allowances by auctioning. Furthermore, the government proposes that no further greenhouse gases or sectors should be added to the ETS, although some marginal adjustments will be made concerning the coverage of certain combustion installations. In addition, for most sectors the allocation will follow the same principles as in 2005–2007, albeit a system of benchmarking will be introduced for orebased steel production.

However, some changes in domestic measures on both the trading and the non-trading sector have been announced. As was noted in the previous chapter, the carbon dioxide tax on the trading sector was suggested to be removed in January 2006 for the industry and (parts of) the combined heat and power producers and reduced for other installations within the energy sector, according to a proposal in the budget bill for 2006.[60] The future aim is to remove the CO_2 tax on all sectors within the EU ETS.

The Swedish government has recently proposed a limit on the trading sector's use of JI and CDM credits within the EU ETS.[61] Thus, Swedish companies participating in the EU ETS will be allowed to use these credits up to a level corresponding to at the most 20 percent of the total amount of allowances allocated for the period 2008–2012.

The electricity consumers, excluding the energy intensive industry, will be subject to the green certificate system that has been proposed to

[59] Prop. 2005/06:184
[60] Prop. 2005/06:1
[61] Prop. 2005/06:184

be prolonged until 2030. The new long-term target is proposed to increase renewable electricity production by 17 TWh by 2016 relative to the 2002 level.[62]

Sweden has a sector specific target concerning the CO_2 emissions from transports within Sweden. Thus, in 2010 the emissions from this sector should be stabilized on a level corresponding to its emissions in 1990.[63] Some new measures are proposed with the explicit aim of reducing CO_2 emissions in this sector. For example, a tax on domestic air travel is proposed and changes in the vehicle related taxation based on the vehicle's CO_2 emission. Furthermore, an indicative target has been proposed specifying that by 2010 the use of renewable fuels for transports should reach 5.75 percent of the total use of diesel and petrol.

Among the other measures that will be strengthened during the coming years, and which applies to both the trading and the non-trading sector, are the investment subsidies through investment programmes with an explicit focus on climate measures (see section 6.1).[64] These investment grants are regarded as very successful by the Swedish government.[65]

[62] Prop. 2005/06:154
[63] Prop. 1997/98:56
[64] Prop. 2005/06:1
[65] Swedish Ministry of Sustainable Development (2005)

Table 6.3 The Nordic countries' planned use of EU ETS and other instruments 2008–2012

	Denmark	Finland	Norway	Sweden
Kyoto gap	17.3 Mt CO_2 eq. per year[1]	11 Mt CO_2 eq. per year	11 Mt CO_2 eq. per year	-0.7 Mt CO_2 eq. per year (but 2.1 Mt above current national target)
EU ETS	Not yet decided. (No explicit restriction on use of JI/CDM credits indicated in national implementation of the Linking directive.)	Not yet decided. (Estimated 5.9 Mt reductions per year used in latest "with measures" projections.)	Not yet decided. (Low coverage of current domestic system reduces the possible use. Discussions on including e.g. the offshore petroleum activities, which would increase the possible use of the ETS.)	Not decided yet. (Allocation proposed to be based on the current national target. Proposed restrictions on the use of JI and CDM credits within the ETS. The ETS could not be used toward the current national target.)
Government use of the Kyoto mechanisms	The government will buy approx. 4.5 Mt per year.	The government plans to buy approx. 2.4 Mt per year	Not yet decided but it is foreseen that the government will acquire Kyoto units if necessary to fulfil the commitment	Approx. 1 Mt per year. Pilot programs. (Not yet decided how these credits will be used. Could not be used toward the current national target.)
Domestic policies and measures	Largely under investigation. (No overall tax increase but possibly tax differentiation. Subsidies to renewable energy. Energy labelling of buildings.)	Approx. 1 Mt per year in total estimated. (Energy conservation important. Attained largely through agreements, energy audits and other energy conservation programmes. Transport related measures will reduce approx. 0.5 Mt per year.)	Small future reductions estimated. (CO_2 tax and voluntary agreements with industry. CO_2 tax on transports is the main instrument to limit emissions. Proposed increase in the tax rate on domestic aviation, domestic shipping of goods and supply ship. Targets on each sectors contribution will be presented.)	Should be used to fulfil the national target, 2.1 Mt per year. (Large number of measures used and proposed. No estimate of effects provided. Indicative (strict) sector specific target concerning the emissions of CO_2 from transports. Increased use of renewables by using green certificates.)

Note: 1) The gap may be reduced to 12.3 Mt if corrections are made for electricity export in the base year 1990

7. Concluding discussion

The overall question for the study that the Nordic Council of Ministers has commissioned ECON to carry out, in co-operation with Electrowatt-Ekono of Finland, is in what way the Nordic countries' climate strategies have been, or at least will be, affected by the introduction of emissions trading. In the study we have presented a comparative analysis of how the Nordic countries have dealt with or plan to deal with the conditions of the EU ETS and the relation to other measures to curb emissions. In order to sum up the discussion, this chapter highlights some main observations and the implications from them.

Many similarities, but also some significant differences

One basic observation is that there are many similarities among the Nordic countries. For example, all Nordic countries have a relatively long tradition of carrying out climate policies, and use, by and large, similar instruments in doing so. However, there are also some significant differences. One fundamental difference is that the relative emission levels vary between the Nordic countries, due to, for instance, varying industrial and energy production structures. Hence, the Nordic countries' international emission reduction commitments, and the challenges it will mean to reach them, vary quite a lot. Furthermore, the relative importance of the EU ETS varies between the Nordic countries, not only due to emission levels but also in the sense that the trading sector's share of emissions varies quite a lot between the countries. This can be illustrated by comparing Finland and Sweden. Thus, the Finnish trading sector stands for approximately 71 percent of the country's total CO_2 emissions, whereas the Swedish trading sector only stands for approximately 42 percent of Sweden's total CO_2 emissions.

Denmark, Finland, Norway and Sweden have all emphasized the cost efficiency aspect of climate policy in their climate strategies and in various policy documents. The countries also stress the importance of emissions trading in this context.

Hitherto relatively marginal corrections of other instruments due to the ETS…

When large scale emissions trading where introduced in January 2005, the new policy instrument seems to have led to relatively marginal corrections of the Nordic countries use of other climate measures. In the EU Member States Denmark, Finland and Sweden the EU ETS was mainly implemented alongside existing policy instruments such as carbon taxes, energy taxes and green certificates, led to only minor corrections of existing instruments. To some extent this seems to be true also of Norway. However, since Norway is not an EU Member State, it could choose a somewhat different approach in the introduction of emissions trading. Thus, Norway uses emission trading as a complement to CO_2 taxation by excluding CO_2 taxed emissions from the ETS.

…but more adjustments will probably follow

According to theory and numerous quantitative assessments, the use of multiple measures to attain the same policy goal is seldom recommended. The interaction between instruments is often complex and there is a risk that the measures act together in a counterproductive way, increasing the overall cost of reaching the goal. The case where CO_2 emissions trading is used with CO_2 taxation is an apparent example where multiple instruments is hindering a cost effective outcome. Based on the cost efficiency aspiration declared in the climate strategies, one should expect the Nordic countries to make some adjustments of pre-existing policy instruments. There are now clear indications that steps are taken in that direction. For example, both Sweden and Denmark are in progress of reducing the emission trading industries' CO_2 tax burden, and Finland will lower the electricity tax on industry within the ETS. However, other climate policy related instruments applied on the trading sectors, such as green certificates systems and subsidies, are still used in parallel with the ETS. This could interfere with the cost effectiveness of the emissions trading system. One should however bear in mind that some of these instruments, like the green certificate system, have other policy objectives.[66]

The countries need to balance the use of ETS and other instruments

Another aspect of the overall effectiveness of the countries climate policies is the allocation of mitigation burdens between the trading and the non-trading sector. Due to the partial sectoral coverage of the EU ETS there could be a problem of "balancing" the use of emissions trading with the use of instruments in the non-trading sector to achieve emission reductions to fulfil the Kyoto commitment. The chosen balance will have implications for the cost of reaching the emission target. The allocation of emissions trading allowances in 2005–2007 gives a first indication of the relative burden between trading and non-trading sectors in the economies. All countries except Norway allocate more than the base year's emissions to the sectors outside power and heat production. The allocation to the power and heat production is for all countries except Finland less than the base years' emissions. The total allocation of allowances seems, however,

[66] It should be noted that Sweden's current national climate target specifies that the greenhouse gas emissions in the country should not exceed 96 percent of the 1990 level. The target should be attained without the use of flexible mechanisms. Given this target, the current use of additional instruments on the trading sector may be (more) motivated from a (domestic) cost efficiency perspective.

in all countries to be lower than total projected "need" in the period 2005–2007. From this point of view, the trading sector has not been "over allocated" allowances.

In the second trading period, 2008–2012, in which the countries have binding commitments, the allocation to the trading sector will be of higher importance as it will be a directly correlated to the measures that have to be applied in other parts of the economy. The countries will have to come to a decision on their respective allocations during 2006.

From an overall cost efficiency perspective, the decision on how large "mitigation burden" that should be allocated to the emissions trading sector, to public purchase of JI and CDM credits, and to domestic measures on the non-trading sectors, respectively, is dependent on several variables, many which today are surrounded by high uncertainty. Important variables are e.g. the cost of further emissions reductions on the non-trading sector, i.e. mainly emissions from transport and heating; the price of credits from JI and CDM projects (and the cost of raising public funds to purchase programs); and the future price of allowances within the EU ETS.

According to various quantitative assessments, further mitigation in the non-trading sector appears to be relatively costly given the current measures that already apply to these emissions. The amount of JI and CDM credits that could be bought with governmental purchase funds depends on the global demand for these credits and the availability of projects, which today is largely uncertain. The price of EU emission allowances, finally, depends on the aggregate allocation in all participating countries, the economic development, the (relative) fossil fuel prices, weather conditions, and the price of credits from JI and CDM projects and more.

Only indications have been given about coming strategies

So far, there have only been indications on how the countries will handle this "national burden sharing" in the period 2008–2012. Denmark, Finland and Norway indicate that relatively small emission reductions are anticipated in the non-trading part of the economy. In the case of Norway, however, it should be noted that the size of the non-trading part of the economy is still uncertain and an expansion of the current limited sectoral coverage may be proposed. Sweden, on the other hand, has an indicative emissions target for the transport sector that specifies that large emissions reductions ought to be achieved in this sector.

The countries with large projected emission gaps in 2008–2012, Denmark, Finland and Norway, has indicated that they intend to allocate a relatively large share of the burden to emissions trading and/or use public funds to acquire credits through JI and CDM projects. Denmark and Finland specify that more than a quarter of their estimated emission gap in 2008–2012 will be closed by public JI and CDM purchase programs.[67] Norway foresees that the state will acquire the necessary amount of JI and CDM credits to comply with its quantitative commitments. This may turn out to be a substantial amount and clearly (primarily) depends on the use of the EU ETS. Sweden has, according to the projections, a negative emission gap and there is therefore no need to use public funds to purchase JI and CDM credits. Nevertheless, Sweden is involved in pilot programs that are estimated to generate credits corresponding to approximately 1 Mt CO_2 equivalents per year in the period 2008–2012.

According to the information available so far, Denmark and Finland will make relatively extensive use of the EU ETS to close the emissions gap in 2008–2012. Less information is, however, available for Sweden and Norway. Given the uncertainty concerning the price of emission allowances, the cost to the economies from far-reaching use of the EU ETS is still highly unsure. Quantitative assessments point toward potentially large effects on some of the trading sectors' international competitiveness, which indicate that, at least in the longer run, costly structural changes may be brought about. However, assessments also show that if these sectors are covered by the ETS, the amount of allowances allocated to them is of less importance for their competitiveness. What is more important in this respect is the cost on the margin, i.e. mainly the price of allowances and the ETS induced price increase of electricity. This, in turn, implies that if the countries whish to preserve the competitiveness of the industry, allocating more allowances might not be an effective way to achieve this. Instead, it could be rational to remove CO_2 and other taxes on these sectors and provide subsidies which lowers the affected sectors' marginal cost of abatement or cost of production in general.

A need for systematic analysis from a cost efficiency perspective

Finally it should be emphasized that, given the potentially complex interactions of different energy and climate policy instruments, any use of multiple instruments should be systematically analyzed from a cost efficiency perspective. In our view, to provide guidance regarding how to balance the climate policy between ETS and other measures, there is clearly a need for assessing the marginal incentive to reduce greenhouse gases that each instrument provides. Without such information, it is difficult to specify a policy that equalises marginal abatement costs, which is a guidance principle for a cost efficient climate strategy.

[67] This is based on a Danish emission gap corresponding to 17.6 Mt CO_2 equivalents per year. The gap may however be reduced to 12.3 Mt (an issue that is not yet resolved, see chapter 2) which obviously would increase this share.

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